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"Objects of utility, not amusement, are now the things which command the attention of the scientific world. The metaphysicians of old occupied themselves in discussing the possibility of two spirits occupying the same place in the same space of time, or the divisibility of spirit. The philosophers of the present age confine themselves to the divisibility of matter—what they can see with their eyes, hear with their ears, and handle with their hands. The spirit of investigation now directed in a right manner—in the true Baconian spirit—traces effects to their causes, and never looks upon a result as worthy of consideration, unless the world in some manner is benefited; and the *world* now, embraces not only princes and patricians, but also mechanics and artizans."—PORTER.

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MESSRS. SOUTTER AND HAMMOND'S SEMI-ROTARY ENGINE.

Fig. 2.

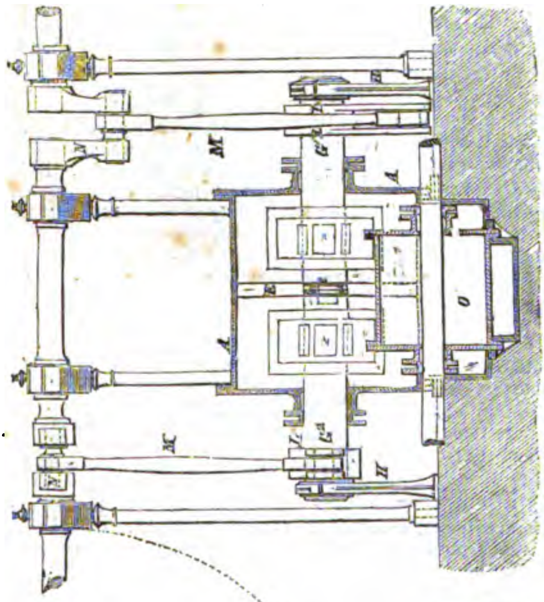
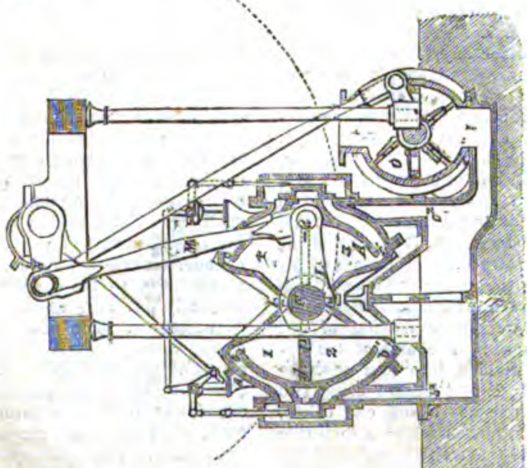


Fig. 1.



MESSRS. SOUTTER AND HAMMOND'S PATENT IMPROVEMENTS IN THE STEAM ENGINE, AND IN MACHINERY FOR PROPELLING.

[Patent dated June 22, 1847. Specification enrolled December 22, 1847.]

Foremost among the novelties presented to our notice by the specification of this patent, is an improved steam engine, of the class called semi-rotary, in which one, two, or more pistons are attached in the manner of leaves to a shaft vibrating or oscillating within a cylinder. It is a very cleverly-contrived engine and does much credit to the rising firm by whom it is patented. Great simplicity and compactness are its striking characteristics. It consists of fewer parts than the ordinary rectilineal reciprocating engine, occupies less space, and consequently weighs less. That it will work well we have not a doubt; and that it will prove also in practice an economical engine (for marine purposes especially) may we think be very reasonably anticipated.

Fig. 1 represents an end elevation, and fig. 2 a longitudinal elevation of this engine as applied to the propelling of an ordinary paddle-wheel steam boat.

We extract the following description from the specification of the patentees:

A, A, is the steam cylinder, which nearly resembles in its external form two spherical frustums united together at their narrow ends. Internally this cylinder is divided vertically by a diaphragm or partition, E, into two equal parts. The piston-shaft, F, which works horizontally, is made in two pieces, G^1, G^2, which are coupled or interlocked together at their inner ends as shown, and have one common bearing in the central diaphragm, E. At their outer ends these half-piston shafts rest on pedestals, H H. The inner end of the half-shaft, G^1, is made to turn freely in a recess or a socket made for it in the inner or abutting end of the other half-shaft, G^2; so that the one half may revolve distinct from and independently of the other. To each half shaft there is attached at right angles a piston, P, which we prefer making of one piece with the shaft. The area of the cylinder is thus divided into four separate compartments, 1, 2, 3, 4; there being two to each piston, one above and one below, or in other words, one chamber on each side of each piston; so that a single engine of this combination is in effect the same as a pair of engines of the ordinary construction. These compartments are made steam tight by means of metallic packings, I, *e*, *e*, at the parts where the central diaphragm, E, is intersected by the half-piston shafts—by similar packings, *d*, *d*, inserted in the pistons all round—and by stuffing boxes at the ends of the cylinder where the half-piston shafts pass through. b, b^1, and c, c^1, are the steam passages, and b^2 and c^2, those leading to the condenser.

The slide valves are of the ordinary sort, and require therefore no description. LL, are beams securely keyed upon the half piston shafts, $G^1 G^2$, which are connected by rods, MM, with the cranks, NN, of the paddle-wheel shaft. These cranks, NN, are fixed nearly at right angles to each other, as is usual, and of course the admission of steam to the various compartments is made to suit this arrangement. OO, is a semirotary and double acting air-pump of the peculiar construction for which letters patent for England were granted to us, bearing date June 22, 1847; but any other kind of pump may be substituted for it if preferred. The mode in which the engine works is as follows:—Suppose steam to be admitted by the passages, b and c', above the piston, in the compartment 1, and below it in the compartment 3, so that while the steam is pressing down on the one side it is pressing up on the other, each half shaft acts as a centre, upon which the piston attached to it may turn, but being of one piece with its piston it is compelled to turn along with it, and thereby gives motion to the beam, L, keyed to that piston, which in turn gives motion to the corresponding crank shaft, and causes it to make one half revolution. On the instant this has been effected the slide valves are so regulated as to come into a position which admits steam by the passages b' and c, leaving b and c' open to the condenser, which produces the succeeding half revolution. A like effect is simultaneously transmitted to the crank shaft from the compartments of the other half of the cylinder by exactly a similar series of movements: and so the operation goes on continuously, as long as steam is supplied to the engine. The position of the cranks on the crank shaft is such, and the movements of the slide valves are so regulated, that when one of the pistons is at the most efficient point of its semirotary course, the other shall be at its neutral, or least efficient point. From the equilibrated manner in which the steam is thus made to act upon the pistons, but little strain comparatively is thrown upon the bearings of the shafts, $G^1 G^2$, or any of the other parts of the engine.

The patentees add the following general observations:

Instead of an engine of this improved description being applied to the propelling of paddle-wheels in the manner which has been just described, it may be so applied as to dispense with two of the cranks and the intermediate shaft; that is to say, by having two distinct cylinders placed as in common engines, and attaching the lever beams to the midship ends of the piston shafts, G^1G^2, and by making the connecting rods to work

Fig. 4.

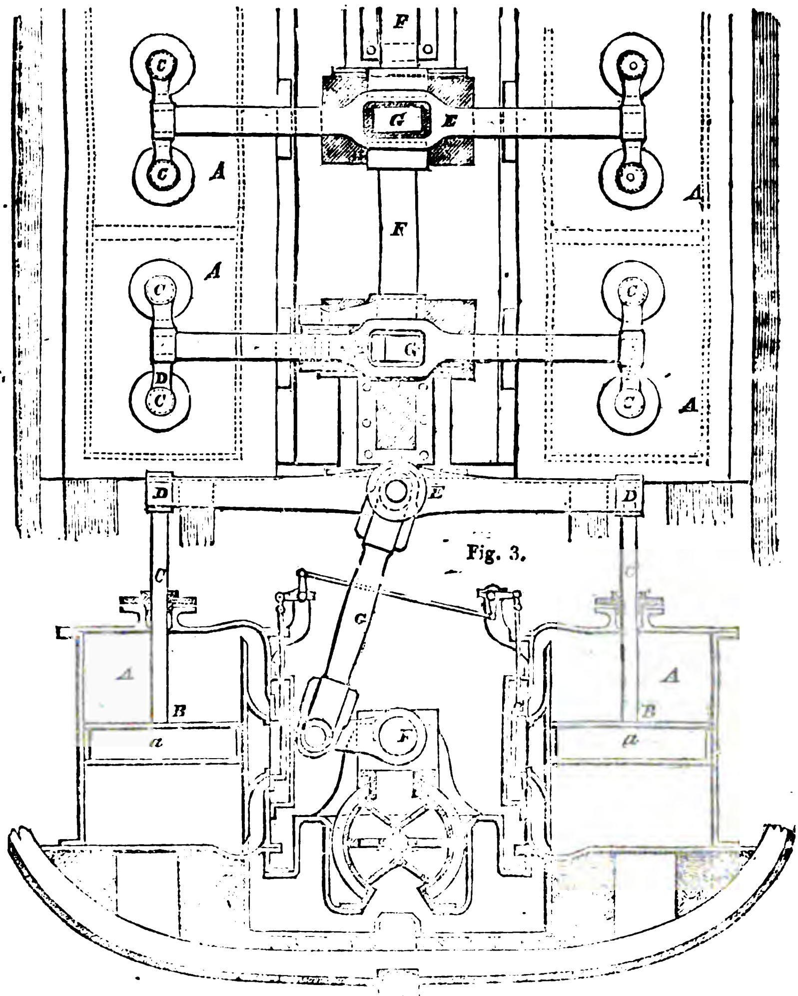


Fig. 3.

on a bent crank pin attached to the two paddle shaft cranks.

When employed to work a screw propeller, (for which this engine is equally well adapted,) the power may be communicated direct to the propeller shaft without the intervention of a second motion; and as the pistons of the engine are in a state of constant equilibrium, there can be no jerking; which is a great advantage where a screw is required to be worked at a high velocity.

In every case this form of engine admits

of a great power being placed in a small space; and on board large vessels the whole of the engines and machinery can be placed under the water line.

A further advantage, peculiar (we believe) to this engine, is, that it admits of the stroke being lengthened or shortened at pleasure. All that is requisite for this purpose is, that corresponding slot holes should be made in the beam attached to the piston rod, and in the crank; by sliding the crank pins into these slot holes, and securing them by means of screws or keys, the leverage may be made either more or less, as may be required, while the piston is travelling the same distance.

And although we have hitherto spoken of this engine as applied to marine purposes only, yet in point of fact it is applicable to all purposes to which steam engines can be adopted, both on water and on land, and whether locomotive or stationary.

The patentees then proceed to show how an engine of this description may be applied to a railway locomotive:

In this arrangement the plan before described is adopted of having corresponding slot holes in the beam and in the crank, into which the crank pins may be slid and secured, and the stroke lengthened or shortened at pleasure.

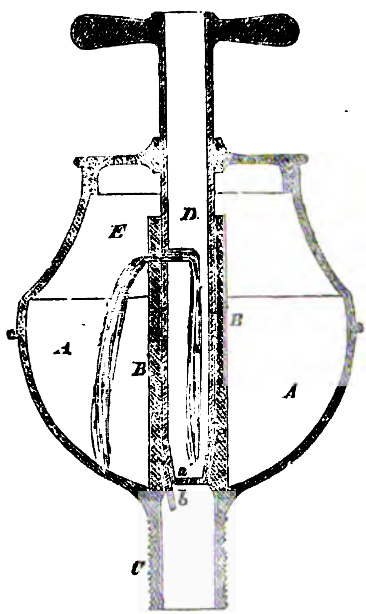
Following the description of this semi-rotary engine, is one of an improved arrangement of the parts of the well-known double-cylinder engine of Messrs. Maudslay and Co. Fig. 3 is a sectional elevation, and fig. 4 a plan of a pair of engines as thus improved in arrangement, adapted to screw propulsion:

A^1A^1 are the cylinders, which, as usual, are four in number; but instead of being, as usual, circular, they are made rectangular, as indicated by the dotted lines in the plan. (Properly speaking, they can no longer be called cylinders, but we adhere to this term for the sake of convenience, as being that which is ordinarily used to designate the vessel or chamber in which the steam is worked.) BB, are the pistons, which are of a form corresponding to the rectangular shape of the steam cylinders, having straight pieces of metallic packing, *aa*, to prevent the escape of steam from the one side to the other. By giving this rectangular form to the steam cylinders and pistons, we are enabled to put engines of greater power in less space than when cylinders and pistons of the usual form are employed.

To each piston there are two piston rods, CC, which are connected to a short cross head, D. The cross heads, DD, of the two opposite cylinders, AA, are connected by another cross head, E, from which the power is transmitted to the propeller shaft, F, by the connecting rod, G. The cylinders, A^1A^1, have similar parts and connections by which the power is transmitted from them to the propeller shaft. The steam valves of these engines may be of any convenient sort. In the figures they are represented as fitted with the common slide; but as this forms no part of our invention, and the manner of working it is well understood, we need only observe that the valves belonging to the corresponding pairs of cylinders must be so set and connected as to act simultaneously in opening and closing the respective ports.

The specification concludes with the following description of a lubricator for steam engines, which is a great improvement on most of those in ordinary use. A sectional elevation of the instrument is given in fig. 5:

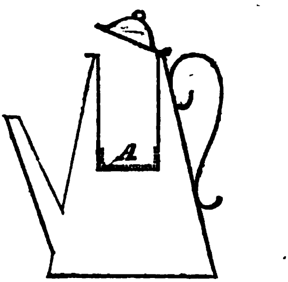
Fig. 5.



A, is the reservoir for the oil; B, a hollow tube or barrel, made in one piece with the body, A, of the vessel. The lower end forms a screw, C, by which it is fixed upon the brass or cover of the journal, or other part to be oiled. D, is a hollow plug, which is ground into the barrel, B, sufficiently tight to prevent the escape of oil between

them at their lower end, except when the holes, *a* and *b*, are brought opposite each other. E, is a thread of cotton, which is passed through holes cut in the barrel and plug, and serves to convey the oil from the reservoir, A, into the interior of the plug, D. When it is necessary to stop the action and prevent the flow of oil—as when the machinery is at rest—the handle of the plug is turned, which causes the openings, *a* and *b*, to be removed from opposite each other, so that no escape of oil can take place out of the apparatus. The flow of oil, however, continues from the interior of the plug until the oil stands at the same level with that in the reservoir, A. The portion of oil thus collected in the interior of the plug serves to supply the requisite quantity which is necessary for the journal or other moving part of the engine upon first starting.

HOW TO PRODUCE FINE COFFEE BY FILTRATION.



Sir,—However perfect in principle Mr. Waller's coffee-pot, in No. 1266, p. 478, may be, I am inclined to think general users will not like to be troubled with cock plugs, stop cocks, valves, and taps.

Accept from an old correspondent the following simple mode of producing fine coffee by filtration, the invention of which was the result of necessitous reflection, as by reason of the usual metal strainers being only *pierced with smooth holes at the bottom* the holes became clogged by the coffee powder lying on them, and the liquid would never flow freely:

Take any suitably made coffee-pot, and put therein a metal strainer, A, pierced not only at the bottom but *a little way up the sides*, yet so as always to be covered with coffee powder. It is essential to the invention, that *the burr of these holes be left on*, like those of a nutmeg-grater, *and be in the inside*; for the following reason; that each hole being a pierced cone, any powder that lodges in or near the hole will, on being agitated, slide away and leave the hole free.

To pour well, the top of the spout must not be higher than the middle of the strainer, which must be large enough for the quantity wanted at one mashing. Put coffee in the strainer, fill it with water, and, if the strainer be correctly made, it will be found that little or no filtration takes place,—leave it thus to mash for a minute, or as long as you please; when you want to use the liquid lift the strainer a little and let it fall, or smack down the lid—the shock will clear the holes, and all the liquid will immediately pass as fine as wine: fill up again as required.

I remain, Sir,
Your most obebedient servant,
J. H. Clive.

4, Atkinson-place, Brixton,
Dec. 20. 1847.

DR. AYRE'S PATENT MANURE-MANUFACTURING PROCESS AND APPARATUS.

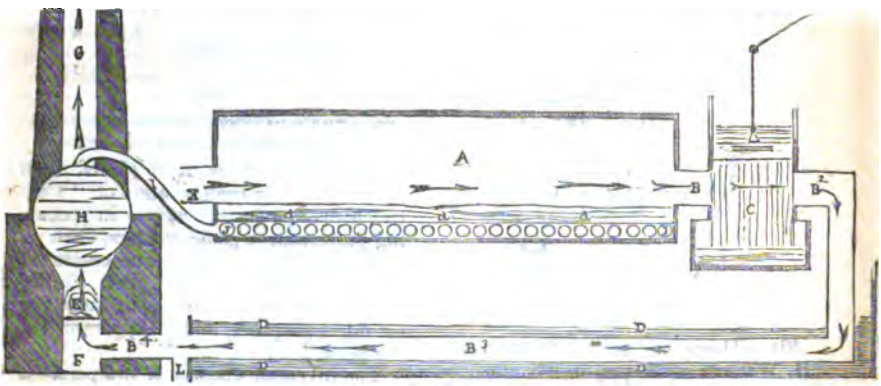
The patent of Dr. Ayre (dated April 20, 1837) is for the invention of "Certain plans and improvements in preparing putrescent organic matters, such as night-soil, the matter in suspension in the water of sewers, and other similar matters for the purpose of manure, or for other purposes, and for apparatus for the same."

The invention consists of two parts—a *process*, and an *apparatus* for performing that process—each of which we shall describe separately.

First, as to the process—It consists in causing the cessation of the putrefactive fermentation, and drying the night-soil or other putrescent matter by the application of a heat short of that by which organic matters are usually decomposed, and at the same time causing the gaseous products of putrefaction disengaged by heat, or some of them, to be absorbed, destroyed, or decomposed in the manner afterwards described. In order to dry the putrescent matters, they are introduced, either alone or mixed with any other substance with which it may be thought proper to combine them, into a covered chamber or oven constructed in the manner to be presently described, and heat applied in any convenient manner—care being taken that the heat shall not be sufficiently strong to decompose or destroy the organic matters, which will be usually

below 400° Fah. The heat is continued until the putrescent matters are well dried, after which they are removed from the chamber.

The drying oven or chamber has an opening at one end, to allow the entrance of atmospheric air, and at the other, a pipe or flue for carrying off the steam and gaseous products of putrefaction. The steam and gaseous products of putrefaction, mixed with atmospheric air, pass through this pipe to another chamber containing a liquid acid, the chamber being so arranged as to permit a large surface of the acid to be exposed, which absorbs the ammonia. If the air, after passing through this chamber, should still be too much charged with steam, or if it be desirable to free it from the steam, the air is caused to pass through a refrigerator, or any other suitable contrivance for condensing the steam; and finally the air, still charged with some of the gaseous products of putrefaction, is passed through a fire, or through or over the surface of burning fuel of any description, in order to decompose the gaseous compounds of hydrogen or other gaseous products with which the air may still be charged; and thus prevent the escape of noxious effluvia. Those parts of the process which relate to the absorption of the ammonia or the condensation of the aqueous vapour may be omitted, the air containing the gaseous products of putrefaction being, however, in all cases passed through a fire, as before described. The process may be performed in any chambers, vessels, and apparatus convenient for the purpose; but the patentee prefers that described as the second part of his invention, and which will be easily comprehended by reference to the subjoined engraving.



A, is a covered vessel, heated by the steam pipes marked J, or in any other convenient manner, on the floor of which the putrescent matters, *a a a*, are to be placed. The chamber has an opening, K, by which air may enter the chamber, and passing over the surface of the heated putrescent matters, carry away with it the gaseous matters driven off by the heat. At the opposite end, or side, of the chamber, is another opening, and a pipe or flue, B, for conducting the air charged with the gaseous products of the putrescent matters to the chamber, or vessel, C, containing a liquid acid, with which the ammonia driven off from the putrescent matters combines. This chamber is so constructed as to cause the acid, when poured into it, to spread over a large surface, which is to be exposed to the current of air passing through the chamber. The surface of the acid may be increased, if desirable, by constructing the chamber, C, with shelves having shallow troughs upon them, into which the liquid acid may be poured. The acid will absorb and combine with the greater portion of the ammonia disengaged from the putrescent matters, and the air, still charged with steam and other products of the putrescent matters, is conducted by the pipe or tube, B^2 B^3 and B^4, to the ash-pit, F, of the furnace, E. The horizontal part of the tube, B^3, passes through a tank, or reservoir of cold water, DDDD, in order that as much of the steam as practicable may be condensed before the air comes to the fire. The liquid condensed in the pipe, B^3, passes through the pipe, L, and falls into a reservoir placed to receive it. The aqueous vapour may be condensed by any other form of refrigerator. The ash-pit, F, of the furnace is made air-tight, or nearly so, in order that the air necessary for supporting the combustion of the fuel in the furnace may be drawn

through the orifice, K, through the chambers, A and C, and along the pipes to the ash-pit of the furnace. The air so drawn in will rise through the fire, the heat of which will decompose the remaining gaseous products of putrefaction which are capable of being burned, and the residue (if any) will pass upwards with the smoke and gaseous products of combustion through the chimney, G, of the furnace. Above the furnace is placed the steam boiler, H, from which the tube, I, conveys steam to the pipes marked J, by which the chamber, A, is heated; the furnace, E, thus answering the double purpose of heating the putrescent matters in the chamber, A, and decomposing the unabsorbed and uncondensed gaseous products of putrefaction. The acid condensing chamber, and the refrigerator for condensing the steam, may be omitted at will; the air from the chamber, A, being, when both are omitted, conveyed unchanged, or nearly so, to the ash-pit of the furnace.

The patentee claims, *firstly*, the mode of preparing putrescent matters by drying the same, and causing the gaseous products to be burned or destroyed, as above described; either with or without causing any portion of such vapours, or gaseous products, to be condensed or combined.

And, *secondly*, the apparatus before described for preparing such putrescent matters.

The theory of Dr. Ayre's process is plain enough, and his application of it sensible and judicious. Putrefaction essentially consists in the decomposition of complex animal substances into simpler chemical compounds. The elementary substances contained in animal matters are carbon, hydrogen, nitrogen, oxygen, sulphur, phosphorus, and certain mineral compounds, which take no part in the process of putrefaction. When an animal substance containing all these elementary bodies putrefies, the carbon unites with oxygen, forming carbonic acid, and with hydrogen, forming carburetted hydrogen; the nitrogen unites with the hydrogen to form ammonia; the sulphur and phosphorus combine with the hydrogen, forming sulphuretted hydrogen, which again unites with the ammonia and produces hydrosulphuret of ammonia, to the vapour of which the nauseous odour is in great measure owing. At the same time, some volatile organic matters are produced which contribute to the offensive odours. The gases and vapours disengaged during the drying of the night soil are carburetted and sulphuretted hydrogen, hydrosulphuret of ammonia, and carbonic acid. With the exception of the hydrosulphuret of ammonia, the gases contained in night soil exist only in very small proportions, and are disengaged almost as soon as formed.

All these gases and vapours, with the exception of carbonic acid, are combustible, and suffer complete decomposition when passed over an incondiscent surface, or through a fire, or when exposed to strong heat after being mixed with atmospheric air. The carburetted hydrogen, produces by its combination with oxygen, carbonic acid, and water; the ammonia frees nitrogen and water; the sulphuretted hydrogen, sulphurous acid and water; and the phosphuretted hydrogen (if present) phosphoric acid and water. Any volatile animal matters are also destroyed by heat, and resolved into the ordinary products of combustion. Consequently, by passing these volatile products of putrefaction through a fire, the whole of them are decomposed and converted into the inoccuous and inoffensive products of combustion.

The causes which have prevented the immediate use of night soil as a manure, are that it is a bulky heavy matter, of a most offensive character, containing a large quantity of hydrosulphuret of ammonia, which is prejudicial to vegetation. The difficulty of transporting this valuable manure, and the length of time required to render it fit for application to the land, have caused it to be accumulated at short distances from our large towns, spread out on the ground, and occasionally turned over until partially dry; at times it is incorporated with other manures, and thus sent into the country. But the bulk and weight, as well as the offensive odour, prevent it from being sent into remote places where manure is most required. By Dr. Ayre's process the putrescent matter is reduced to comparatively small weight without any diminution of its fertilising principles, since the ammonia drawn off by heat is again collected and employed to augment the properties of the manure.

We are informed by the patentee that the night soil dried in the manner just described is only inferior to the best

guano in its fertilising properties; and that it is much superior to a great part of the guano in the English market. The analyses of this dried night soil have not yet been completed; but sufficient has been done to demonstrate the value of the manure. The dried night soil contains from 8 to 10 per cent. of nitrogen. The ashes of the manure amount to about 25 per cent.; they contain 15 per cent. of alterative salts—phosphates and sulphates of potass and soda, and chloride of sodium, and 55 per cent. of phosphates; the remainder consisting chiefly of sand and earthy matters.

We look upon this invention as a valuable addition to the means we possess of converting the noxious accumulations of animal matter in our large towns into the means of increasing the production of food; at one and the same time improving the sanatory condition of our towns, and augmenting the material resources of the country.

IMPROVED MODE OF TRUSSING IRON GIRDERS.

Sir,—In a previous communication on this subject, I alluded to the experiments of Mr. Cubitt in corroboration of some previous remarks I had made in your Journal.

The cause of the results there shown may be graphically explained by reference to the accompanying diagrams, figs. 1 and 2. Fig. 1 is a girder trussed in the ordinary way, and fig. 2 the same, deflected by a load. From the point, E, in both figures, three bars, EH, EA, and EG, proceed, the upper ends of which are attached to the girder, at the points H A, and at the point, G, to a supposed extension of the girder, for the purpose of affording a connection to the truss at that point.

By comparing the lines, EH, EA, and EG, (fig. 2,) with the corresponding ones in fig. 1, it will be seen that EH is considerably extended, EA slightly so, while EG is greatly diminished in length. The reason is obvious, for in consequence of the material below the neutral axis, *ab*, being extended, the point, H, recedes from the point, E; but above the neutral axis, where the line, AB, is compressed, the points A and C are brought more vertical with respect to E, and therefore lessen the distance; and hence the tension in the oblique bar is lessened as the upper point of attachment recedes from *a*, until it becomes equal to zero. After which the oblique bar has to resist a compressive force—as is evident by shortening the distance, EG.

The girder, ABCD, (fig. 1,) as before stated, is of cast iron, of rectangular section, trussed in the ordinary way with the tensile truss, AEEB.

Fig. 2, is the same girder deflected by extraneous pressure to the breaking point.

The vertical scale of these diagrams is greater than the horizontal scale, in order that the mode of action may be more clearly explained and more easily understood.

The dotted line, *ab*, is the neutral line, or axis of the beam, above which all the material is compressed, while all below it resists the effects of the weight by tension.

A weight placed upon the girder, fig. 1, will, by extending the lower and compressing the upper fibres, cause the girder to assume the form fig. 2. A part of the tension of the lower fibres is conveyed to the truss by means of the pieces, IE and KF, which are cast to the girder; and if the bars, AEFB, be measured in figs. 1 and 2, it will be found that those in fig. 2 are, as before stated, somewhat lengthened, and therefore resist a tension proportional to the increased length. But whatever be the amount of tension that exists in the horizontal bar, EF, it is reacted from the point A and B, increasing the compression in the line, AB, exactly as much, as it relieves the tension from the line CD.

The effect of this compression is exhibited in fig. 2, where the points A and B are removed from the positions they would have occupied if the truss had not been applied to the point A and B. The spaces between AB (fig. 1,) and AB (fig. 2,) show the increased compression in the upper part of the girder consequent upon the use of the truss.

Hence, since the force that is deducted from the side of the neutral line is added to the other, it follows that little or no increase of power could arise from trussing a girder; as fig. 1, and all experiments that have been made prove this to be the case.

The modulus of elasticity is twice as

great for cast iron as it is for wrought; it therefore follows that wrought iron will extend as much again as cast iron will, under similar forces. It is therefore impossible that the truss and girder in the ordinary application can be strained proportionably—the wrought-iron truss having only half the strain to resist which the cast girder has.

There are, therefore, two difficulties to overcome, in order effectually to apply the truss to the cast girder. First, to

Fig. 1

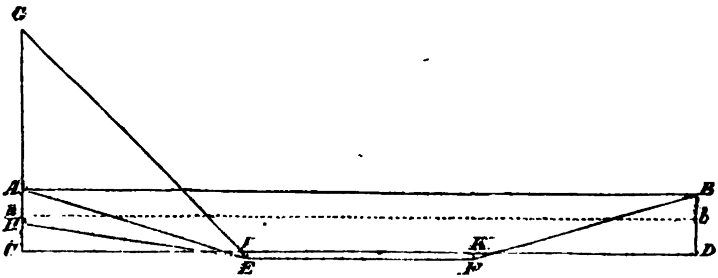


Fig. 2.

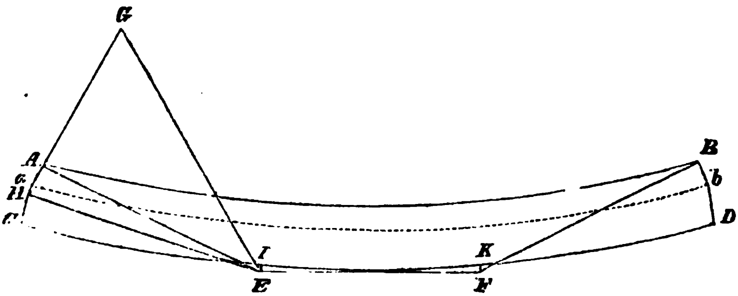
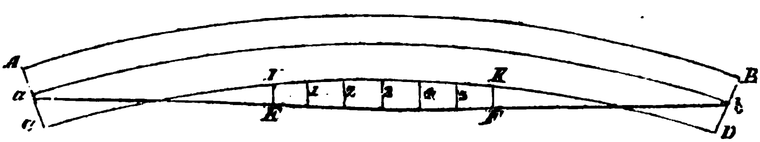
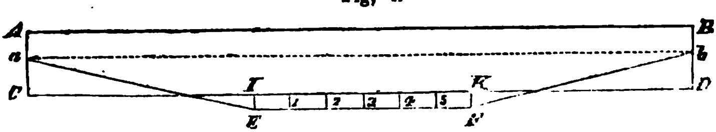


Fig. 3.



Fig, 4.



prevent the prejudicial compression in the line, AB, which I have shown above weakens the girder to the extent of such compression; and, second, to allow for the difference in the elasticity between the cast and wrought iron.

The first of these difficulties I propose to overcome by attaching the upper end of the tension-bars to the girder, either at or rather below the neutral axis. In figs. 3 and 4, it is connected at the neutral axis at the points *a* and *b*.

The effect of this is to bring the compressive reaction of the truss to the neutral part of the beam; which is useless as far as transverse strength is concerned, but may be advantageously employed in resisting that pressure which, if applied above the line *ab*, would prejudice the strength of the girder. By connecting the tension-bars at these points, therefore, instead of at the points A and B, (figs. 1 and 2,) the girder is increased in strength by the truss very nearly as much as is due to the tension in the bar, EF.

To accommodate the structure to the difference in the elasticity in the wrought and cast iron, I proceed thus:—Let the girder be curved upwards so much that when loaded the deflection caused by the load shall bring it to a horizontal position, as fig. 3, which shows the form of girder before the weight is applied, and fig. 4, which is the same girder loaded. Divide the space, IK, into any number of equal parts—11, 12, &c., &c., and let the pieces 1, 2, 3, 4, 5, be cast to the girder, so as just to touch the horizontal bar, EF. The consequence will be, when the beam is brought to a horizontal position by the application of the weight, that, independent of the points *ab* and IK being further apart because of the extension of the cast iron, and the curve becoming a horizontal line, the pieces 1, 2, 3, 4, 5, pressing upon that part of the truss, EF, will give it a downward curve equal to the upward natural curve given to the girder. And hence the tension-bars are increased in length in a greater proportion than the lower part of the beam, CD, that is, thus arranges itself to the difference of elasticity between it and the material composing the girder.

By the adoption of these arrangements, the full strength of the truss may be made available to support the structure.

Believing the above considerations are new, and of considerable importance, I beg to forward them to you for publication.

I am, Sir, yours, &c.,
WILLIAM DREDGE.

10, Norfolk-street, Strand,
Dec. 22, 1847.

CAMBRIDGE MATHEMATICS.

Sir,—A short time ago there appeared in your Magazine a review of Mr. Potts' Appendix to his Euclid. Intermingled with this, were some stringent observations on the state of geometrical learning at Cambridge. The first of these matters I shall leave untouched, especially as I fully concur in the encomiums bestowed on Mr. Potts. But, although I am myself an ardent disciple of the pure geometry school, I am compelled to dispute many of the positions assumed on this head in the article in question, and more largely set forth, doubtless by the same hand, in the Number for last week.

In the first place, then, your reviewer seems to forget that the chief, avowed, and immediate object of Cambridge education is not simply the production of mathematicians, denoting by that term those versed in physics, symbolical analysis, or pure geometry; it were vain to look for such a result from the three years' study of youths not matured in age, and compelled to devote much of that time to the other departments of knowledge. Cambridge affords a mental gymnasium, where those who desire to test their powers may do so in many struggles in various sorts of mental competition, and in a field crowded by hosts of eager combatants. The body, if trained only by exclusive exercise in the heated atmosphere of a gymnasium, will not be rendered powerful for the duties of every-day life. No wonder, then, if many are so overstrained by the forced mental development of a university education as to become inert after the struggle for a degree, and perhaps disgusted with the whole process of obtaining it. But your reviewer does not seem to me to give due credit to the continued endeavours of the University to remedy such evils. His description of the Senate-house papers surprises me; and I must say, that if papers such as he describes are lauded in Cambridge in proportion to their novel aggregations of difficulties, the commendation comes not from those whose praise is valued. Indeed, the cleverest examiners are well known as those from whom is expected the easiest style of questions; and I appeal to the last ten years for evidence of marked improvement in the simplicity of the questions, the elegance of the problems, and the practical tendency of the book-work papers. Again; as to the abandonment at Cambridge of the study of the pure geometry, we could not but expect such to be the case under existing circumstances. The Greek geometry is undoubtedly by its accuracy, and, I may say, by the tangible instruments it uses, as well as by the results being ever patent to the mind—the most noble handmaid of clear thinking and rigid reasoning. But, Sir, when your reviewer asserts that the actual

process of solution or of proof is even generally facilitated by this engine, I must beg to differ from him, and in doing so to employ in the handling of a problem or theorem those means which to me are the most potent for its explication. To come somewhat more to particulars—Are we to impugn a result because it tells of cases to which we cannot find an application? Are we to condemn a solution because to the ordinary result furnished by geometry is added a number of complicated particulars, some of which are doubtless yet inexplicable, but many of which, beautiful and instructive, could never have been filtered through the line and circle? Can geometry help no more than algebra to the true apprehension of physical relations? How are force and velocity denoted even by Newton in his geometry?—Or is even *his limit* more satisfactory than the sum of an infinite series? The fact is, Sir, that the time given to science in Cambridge is far too short to allow of much being learned; but surely when but a hurried glimpse can be taken of the structure of mathematics, transversals should yield to integration, and radical axes give way to conjugate lore. In the Dublin University, where the students are generally three years younger than those in Cambridge, much of the initiatory time is devoted to pure geometry, but it is universally found that on the removal of the immediate pressure which compels them to solve questions by geometry, Euclid is driven out of the field by xyz. Your reviewer writes as though the puzzling intricacy involved in many geometrical problems were really of advantage in teaching the student how to think. Now it appears to me that the thought most required for strengthening the mind is that which is employed in the logical sequence of processes, not on the simultaneous apprehension of complicated constructions.

But the most serious charge I bring against the articles I am considering—and I keep it for the last—is that which upbraids the Cartesian geometry, because it is after all founded on the ancient system, making it therefore a cause of blame that its founders should not have entirely discarded former science. Why, Sir, we might in algebraic geometry adopt what symbols for a given condition of lines and what interpretation of given symbols suited our fancy, provided that no two dicta were opposed to or inconsistent with each other. Thus your reviewer is mistaken when he asserts that the explanation of the sign $-$ had to be sought for in geometry. On the contrary, it was assigned to a certain condition, and might have been given to a totally different one, say to the condition that a right line $-x$ shall be measured in a direction perpendicular to the right line $+x$. No algebraist denies the truth of geometrical principles, but the signification he gives to his own symbols *in initio* is perfectly arbitrary—subject to the exception mentioned above. Is he then to be blamed because he makes his interpretation agree with the already established conveniences of that geometry which his opponent so strenuously upholds? It is natural that after long confinement to the poles and polars and the pure geometry, and on the bursting forth of the Cartesian system, the tide of study should press up this new-opened channel, and overflow, perhaps, and leave all others dry. But it surely will return, and that equilibrium must be restored which each department of science is intended to maintain; and I rejoice to observe that there is at Cambridge a strong reflux in this direction, evident of late years by its action, and the ready supply of books necessary for the diffusion of geometrical knowledge amongst the students.

The concluding paragraph of the article on this subject last week, leads me to hope that you will allow me to speak thus boldly; and while I have been a silent spectator of many a hard-fought battle on the ground of science in your Magazine, and have watched the impartial facilities supplied to both parties, I am induced to anticipate that, when reluctantly stepping into the arena myself, the same indulgence will be afforded to

Your most obedient servant,

$\pm$

Temple, Dec. 20, 1847.

TO PREVENT SOURNESS IN MILK, CREAM, AND BREAD.

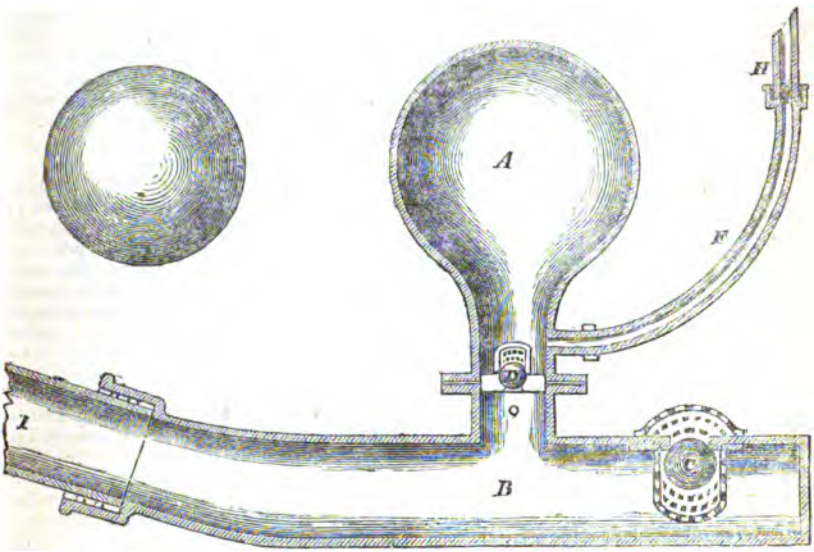
It is not generally known that the sourness of milk and cream may be *immediately* corrected by the addition of a small quantity of the common carbonate of magnesia, in powder. Half a teaspoonful (about equal to 4 grains) may be added to a pint of milk or cream, if only slightly sour—a larger quantity in proportion to the degree of sourness.

From 2 to 3 grains may be added to every pound of flour to prevent sourness in bread, so injurious to some constitutions.

Carbonate of soda is sometimes employed for the same purpose, but it communicates a very unpleasant flavour to the bread, and in the case of milk or cream is worse than the disease.

ROE'S SPHERICAL-VALVED HYDRAULIC RAM.

[Registered under the Act for the Protection of Articles of Utility. Freeman Roe, 70, Strand, London, Hydraulic Engineer, Proprietor.]

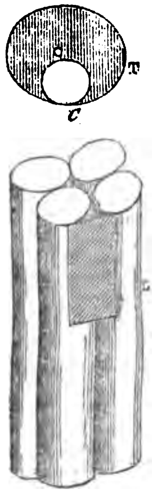


The above figure represents a valuable improvement in the water-ram, which has been just made by Mr. Roe, the eminent hydraulic engineer. A, is the air vessel, as usual; B, the body, upon which the air vessel and the pulse-valve, C, are fixed; D, the air vessel valve. The valves (C, D,) both of the air vessel and pulse-valve, are of the description known as the spherical valve, but possess the peculiarity of being elastic or flexible, consisting of vulcanized India-rubber or gutta percha, which forms an air and fluid-tight obstruction to the return of the fluid after having passed through the valve into the air vessel. F, is the supply-pipe, which is composed of several lengths of piping, joined by passing a ring of vulcanized caoutchouc or gutta percha round the small end of one pipe and inserting it into the large end of the next preceding length, (as shown at H,) and so on until a sufficient length has been obtained. The injection-pipe is joined in a similar manner.

IMPROVEMENT IN CIGAR-CASES.

Sir,—Cigar-cases, when strong enough to protect their contents, are generally too heavy for the use of sportsmen, or those who object to the encumbrance of unnecessary weight. I think that a cigar-case made upon the following plan would combine strength and lightness, and would, besides, be very compact, cheap, and durable. If it be desired to form a case to hold four cigars, we may take four pieces of brass, or japanned tin tubing, and solder them together as in the sketch. The lower ends are to be closed, and a wire fixed in the middle of the tubes. T, is the circular top, which has a circular piece cut out, as at C. This cover revolves on the wire, and being riveted on rather stiffly, will retain the cigars in their places until it be so turned as to cause C to correspond with one of the open tubes.

A flat piece may be soldered on at L, which will form a cavity to contain "lights," and, if thought requisite, the opposite cavity may be filled up by a catch-spring, to project into C, and thus



retain the cover in a position which will close the whole box.

I am, Sir, yours, &c.,
JOHN MACGREGOR.

London, Dec. 27, 1847.

THE CAUSES AND EFFECTS OF EXPLOSIONS IN STEAM ENGINES INVESTIGATED; AND THEIR RESULT FROM AN EXPLOSIVE PRINCIPLE DIFFERENT FROM THE FORCE OF ELASTIC STEAM DEMONSTRATED; WITH AN EASY AND CERTAIN MEANS OF PREVENTING ITS DESTRUCTIVE EFFECTS, AND REDUCING IN GREAT PART THE ENORMOUS WEIGHT OF ENGINES. BY JOHN WILDER, NEW YORK.

[We reprint this paper from a pamphlet published at New York, with an early copy of which we have been favoured. The views of the writer are original, and whether sound or not, rest on facts which have not been hitherto sufficiently considered. If he has not found out the true cause of the prodigious explosions in question, he has at least pointed out very clearly where it is to be looked for. We recommend his lucubrations to the special attention of our esteemed correspondent, "A. H."—ED. M. M.]

In November, 1846, the steamboat, *Atlantic*, left Allyn's Point for New York, with the wind strong at northwest. A few minutes after passing New London Light, the bursting of the steam-chest occurred, which disabled her engine. Shortly after she was brought to anchor with two chain cables out, to which was afterwards added a hawser with 3200 lbs. of grate bars attached; but she continued to drift for several miles, and 23 hours after the explosion was wrecked on Fisher's Island, the commander and many others perishing.

In the inquest held on the occasion, the coroner's jury assigned the bursting of the steam-chest as the primary cause of the loss of life, which for judicial purposes appears sufficient, since there was no evidence of imprudence or want of care. But a more thorough investigation of the real causes of the explosion which disabled the *Atlantic* in the first instance was required by considerations of future security; for there has not since appeared the least reason to doubt their identity with the causes of the explosion of the *New England*, at Saybrook, many years before, or of those of the explosion in the towboat, *Phœnix*, at the Balize, in November, 1846, or of the violent explosion of the steamboat, *New Hampshire*, on Arkansas River, in May, 1847, or of any other of which we have heard, whether in marine or land engines.

The *Atlantic* was one of the finest steam vessels ever built; nothing has been omitted which was supposed could add to her strength and security. Her engine was of the same pattern and dimensions with those of the first-class boats—*Hendrick Hudson* and *Cornelius Vanderbilt*. The diameter of the cylinder, 72 inches; length of stroke, 11 feet; area of the piston, 4071 square inches; capacity of the cylinder, 311 cubic feet; of each valve chamber, 10 cubic feet; capacity of cylinder and valve chamber together, 321 cubic feet.

The measured strength of her beam, crank, shafts, &c., was fully equal to a force of 500 lbs. on every square inch of the area of her piston, which does not exceed the average strength of machinery in the best boats latterly built; and since the necessity for such great strength has been proved by long-continued and general experience, it is evident that it is no more than equal to the forces which occasionally act on the piston.

The beams, cranks, shafts, &c., of the steamship *Washington* greatly exceed even this enormous strength; being equal to a force of more than 700 lbs. on every square inch of the area of her pistons. The prodigious weight and strength of her machinery are evident from her being advertised for 300 tons only of freight, to a burthen of 1750 tons; leaving more than 1400 tons for the machinery and fuel, in proportions not very unequal.

If an ordinary cylindrical engine boiler,

partly filled with water, have its safety valve and all other outlets firmly closed, and a strong fire be raised underneath and continued, part of the water therein will be converted into elastic steam, which in every direction will press with equal force on equal surfaces. The force of the steam will increase with the continuance of the fire, until it equal the cohesive strength of the boiler, which will then burst open in its weakest part; and this will invariably take place under similar circumstances; for it is manifest that the force of elastic steam can never exceed the strength of the boiler in which it is generated.

The ultimate force of elastic steam is not yet known; nor were other powers than those of an elastic and uniformly expansible gas recognised therein, before the invention of the steam engine; nor have they been indicated by the safety valve or developed by Papin's Digester, which on a small scale, is a boiler with a safety valve, but without an attached engine.

If a given volume of water be taken as unity, at the same temperature and weight, atmospheric air will be 813, the vapour of water 1300 nearly, and heated to 212° Fahrenheit, in the form termed steam, rather more than 1700 times the bulk of water. Steam is sometimes defined as water combined with elementary heat, and in the form of elastic gas; but the combination is very slight, and exists only under a degree of compression; hence it is apparent that the withdrawal of the compressing force must set free the elementary heat, or caloric, the powers and properties of which are very little understood; and the less, because the results of the decomposition have not been distinguished from the effects of elastic steam in a state of combination.

In every case of explosive action wherein the results have been appreciated, there has been a concurrent decomposition of the explosive compounds, and much of the mystery which has enveloped the explosions in steam engines, is the consequence of taking it for granted that in this particular they were an exception to all other explosive phenomena.

In a paper on the explosion of engine boilers, by Jacob Perkins, published in the *Franklin Journal* of June, 1827, an instance of explosion is given in these words:—"A stronger case still was that of an explosion at the iron foundry, at Pittsburgh, North America. As is the practice in North America, a high pressure engine, of sixty or eighty horses power was supplied with steam from three separate cylindrical boilers, each being thirty inches diameter and eighteen feet long. One of the boilers had been observed for some time to be getting red hot, but as the other two supplied a sufficiency of steam for the work then doing, it was disregarded until it exploded. The main body of the boiler separated from one of its ends, at an angle of 45 degrees, and passed off like a rocket through the roof of the building, and landed about 600 feet from it."

The instance is given to support Mr. Perkins' opinion, that explosions often result from the sudden and rapid formation of elastic steam, in consequence of the rising of the heated water into the overheated portions of the boiler; but although steam of great force may burst open a cylindrical boiler, laterally and in its weakest part, it can never rend it asunder endwise, as described in the instance at Pittsburgh, because the amount of metal which in all cylindrical boilers resists the pressure on the ends, is double of that which resists an equal lateral pressure. For, if the girth of a cylindrical boiler be taken, and the boiler be measured in length equal to half the girth, the area of a rectangular section of the part thus measured, made by a plane passing through its axis, is equal to half the circumference multiplied by the diameter; but the area of the circular section made by a plane passing through the boiler perpendicular to its axis, is equal to half the circumference multiplied by half the diameter; hence the force of steam, perpendicular to the rectangular section, is double the force perpendicular to the circular section, for its area is double. But the amount of metal shown by the respective sections, and which resists the pressures perpendicular thereto, is equal by measurement. Therefore, it is impossible that a cylindrical boiler should be rent asunder endwise by the force of elastic steam, since half the force requisite thereto would burst it open laterally.

Boilers are not made perfectly cylindrical, the lap-joint causing an inequality of diameter equal to the thickness of metal. For this reason the direction of the weakest part of the shell or circumference must be lengthwise. When at work they always contain more or less water, which would vary somewhat the intensity of the force on different parts of the circumference.

In 1838, the steamboat *Moselle* exploded her boilers at Cincinnati, throwing the heavier end of one ashore to a distance of several hundred feet. The *Creole* burst all her boilers and threw one ashore, when leaving Bayou Sara, in 1843. The towboat *Phœnix* threw both her boilers overboard by an explosion at the Balize almost on the same day the *Atlantic* was wrecked. The *Medora* exploded her boilers and threw them over her stern into the Missisippi, Febru-

ary, 1847. The *New Hampshire*, on Arkansas River, in a most violent explosion, in May, 1847, threw the end of one of her boilers to the distance of several hundred feet.

The following article, from the *Baltimore Sun* of February 4, 1847, is copied from the *New York Tribune:*

"*Explosion.*—About two o'clock yesterday afternoon, one of the boilers of the Linseed Oil Mill of Messrs. T. and J. M. Smith, on Pennsylvania Avenue, burst, producing an explosion which was heard over the greater part of the city. The mill was driven by two boilers about twenty inches diameter by twenty-two feet in length, one of which parted about the centre, one end being carried about 400 feet into an adjoining field, while the other was driven quite through a small frame house in the rear of the mill, occupied by Mr. Medner, making an ugly breach in the front wall of the house, and lodging in a shed room in the rear."

A cylinder is defined: "A solid figure described by the revolution of a right-angled parallelogram about one of its sides, which remains fixed. The axis of the cylinder is the fixed straight line about which the parallelogram revolves. The bases of the cylinder are the circles described by the two revolving opposite sides of the parallelogram." Hence the section of a cylindrical boiler, made by a plane parallel to its ends is a circle, the area whereof is equal to the area of the rectangular section made by a plane passing through the axis of a portion of the boiler, one-fourth of the circumference in length. The pressure of elastic steam perpendicular to each section is equal, since the areas are equal; but the amount of metal, the cohesive strength whereof resists the pressure parallel to the ends, is the whole circumference of the boiler, while that which resists an equal lateral pressure, is two portions of the circumference, each equal to one-fourth thereof.

The diameter of the boiler which exploded at Baltimore is stated in the *Sun* at 20 inches; the circumference, therefore, 62.82 inches, one-fourth whereof, 15.705, multiplied by 20, the diameter, gives 314.1 square inches as the area of the end of the boiler; but the whole periphery or ring resists the pressure on the ends, and its cohesive strength is the circumference, 62.82 inches. In like manner the rectangular section of the boiler, made by a plane passing through a portion of the axis one-fourth of the circumference in length, is 15.705, multiplied by 20, the diameter, is equal to 314.1 square inches, the area; and the pressure perpendicular thereto, the effect whereof is to burst open the boiler laterally, is resisted by the cohesive strength of half the circumference, 31.41, or the two portions of the ring or periphery, each 15.705 inches long: Wherefore, in all cylindrical boilers, the amount of metal which resists the pressure on the ends is double the amount of metal which resists an equal lateral pressure; and it appears impossible that they should be rent asunder endwise by the force of elastic steam, which can never exceed the strength of the boiler in which it is generated.

The area of a circle is greatest in respect of its periphery, of any figure whatever; much less, therefore, can a boiler not cylindrical be rent asunder endwise by the force of steam. But numerous cases have occurred wherein boilers have been rent asunder endwise, which could only be effected by an almost unlimited explosive power. No trace of such power is found in the history of boilers other than those of steam engines; nor in these has it been indicated by the safety valve or steam gauge, although they show, with sufficient precision, the variations in the strength of steam. Against the force of elastic steam, as generated in a boiler, a properly loaded safety valve is a complete security, but it has not the least value as against the effects of explosive action.

The strength of the beam, shafts, cranks, &c., of the *Atlantic*, has been noticed. They were strong enough to sustain a force of more than 500 lbs. to every square inch of the area of her piston, although 50 lbs. to each square inch of her safety-valve would be deemed an improper and dangerous load; yet the average strength of the "working gear" in the best steamboats is not less than in the *Atlantic*,—although none will admit, nor is it likely that they ever use, steam of one-tenth of that strength.

The cost, and inconvenience in navigation, of the weight of iron requisite for such strength is so great, that nothing but a conviction of its necessity could continue its employment. It is certain, therefore, that there exists within the cylinder a power equal to the resistance offered by the enormous strength of the working gear. The area of the steam valve is in common practice about one twenty-fifth part of the area of the piston, hence the action of steam on the piston can only have a twenty-fifth part of the velocity with which it passes the steam valve, and its sudden and violent action on the piston, in consequence of a flow of steam from the boiler, is apparently impossible. Besides, the force of steam in the boiler can never exceed the load on the safety-valve, and its action on the piston must have a direct relation to that load; and in marine engines, to the dimensions of

the paddle-wheels and the density of water, which can only offer a limited resistance to the force of steam on the piston: Wherefore the power that breaks shafts, cranks, beams, &c., of a strength of six or eight hundred pounds to every square inch of the area of the piston cannot proceed from the boiler, but must originate within the valve-chamber and cylinder, where there is but a single known cause adequate to its production.

At high temperatures the combination of water and caloric in the form termed steam is so very slight that it can only be continued in close and strong vessels, and under a consequent strong pressure. This combination ceases instantaneously if the pressure be suddenly removed; nor, after the separation, can the constituents be recombined by any known means without previous reduction.

If, therefore, the steam in an engine boiler be of a high temperature, and the steam valve be suddenly opened, steam will rush into the valve chamber, part of its caloric separating from the partial removal of the pressure, and passing in first from its immense velocity, but there is no passage for its farther escape; and it may react or produce by its own inherent power the explosive phenomena which have been often observed, but not traced to their real cause, nor their analogy or extent properly estimated.

When fire-arms, properly loaded, are discharged, the wad or ball traverses the bore of the piece with a motion much slower than the initial velocity of the gas liberated by the combustion of the powder; the gas is therefore under a degree of compression which keeps its constituents in combination, until they leave the chamber of the gun, when they separate instantaneously; but if there be a space or interval between the powder and the wad or ball, the piece will burst, and the more certainly as the interval is greater.

The fatal instance of Captain Stockton's gun bursting, as is alleged, from an interval between the powder in the conoidal chamber and the wad, must occur to every one. If the muzzle of a gun be barely held under the surface of water, or closed with a wad, the bursting seldom fails. That it does not result from the expansive force of the liberated gas is certain. The measured length of the United States' musket is 40 inches; the greatest diameter of the barrel 1 inch 3 lines, least diameter, 11 lines; diameter of the bore, 8 lines: hence the thickness of the metal of the barrel is at the breech of the gun $3\frac{1}{2}$ lines, which taken on each side of the bore is 7 lines, the cohesive strength whereof to resist the bursting of the gun, is in one inch of its length equal to 40,000 lbs., and in two inches 80,000 lbs., and in the whole length of the barrel, allowing for the diminution of the diameter, not less than 1,200,000 lbs.

The specific gravity of gunpowder as loaded in a musket is to that of atmospheric air as 640 to 1, nearly. The specific gravity of the gas produced from the combustion of the powder is commonly taken as equal to that of atmospheric air, although greater. If, therefore, a United States' musket be loaded to the depth of 2 inches, and firmly closed to that space and then fired, allowing that the whole substance of the powder is converted into gas, the force or pressure of the gas, if its temperature be not raised, would be but 12,000 lbs., and 80,000 lbs. is required to burst the gun, and the gas cannot be expanded to that force at a less heat than would melt silver; but $\frac{25}{100}$ of the powder is potash in a state of minute division, which expands but little by heat. It cannot, therefore, be admitted that the expansive force of the liberated gas is the sole cause of the bursting of the gun.

If the inclosed space be doubled in length, the cohesive strength of the barrel is also doubled, or is that of 4 inches of the length of the barrel, but the whole force of the inclosed gas remains the same; that is, it acts with half its original intensity within a double space.

If the gas be allowed to expand to the muzzle, its whole force remains unaltered, but it acts uniformly through the whole length of the barrel with one-twentieth of its original intensity on a given surface; but the cohesive strength by which the expansive force is resisted, has increased fifteen times beyond that which resisted the initial force resulting from the combustion of the powder.

Similar conditions as regards the strength of the piece, and the force of the gas liberated by the combustion, must obtain in every instance wherein a gun properly loaded with powder and a ball or wad is fired; but the gas from its expansive force must move with great velocity in the direction of the bore of the gun, and the result must be that the whole force of the gas, that is, its weight multiplied by the square of its velocity, must act chiefly in the same direction, and its lateral action must become less and less. That this holds good practically, is evident; for when strong steam is let off from a boiler, it rises in an unbroken column to a considerable height above the escape pipe, with no apparent increase of diameter, although free to expand in open space. Nevertheless, if a musket loaded with a full

charge of powder, have a cork fitted into its muzzle, accurately but not tightly, and be then held upright and fired, it will certainly burst, although the initial force of the liberated gas cannot be greater than if loaded in the ordinary manner when no bursting occurs. Neither can the cork offer any resistance to the expansion of the gas which can be appreciated; the effect is therefore produced by an explosive power which cannot pass the cork, otherwise it would escape into free space.

But the explosive power can have no density or magnitude which can be appreciated, otherwise it would remove the cork by impact, or push it out by giving motion to the column of air interposed between the powder and cork. Therefore, the explosive power can only be, one of the imponderable fluids, as they are termed, and caloric is known to be present in large amount at the combustion of gunpowder. It is also known that the velocity of caloric is nearly unlimited, compared with that of gas, with which at high temperature it may be combined.

(To be continued.

OKEN'S PHYSICO-PHILOSOPHY.*

Is there to be no end to the mania for the importation of German notions of art and science? At one time we have a Saxon Doctor brought over to teach us—people of the land of Watt and Woolf—the true theory of the steam engine. At another, comes a Freyberg professor, who condescendingly offers to give us a thorough insight into the whole system of mechanics—so strangely neglected by our own Robinsons, Gregorys, Whewells, Moseleys, and Willises. And now, to cap the folly of the day, a Doctor Lorenz Oken makes his bow, whose mission it is to show us physics spiritualized (!)—applied to the establishment of doctrines and dogmas in ethics and divinity with which no one before ever imagined physics to have any earthly connection.

Were this Germo-mania confined to individuals it might perhaps be safely left to work out its own cure; but it has caught hold of societies and institutions as well, and is become thereby a more obstinate thing to deal with. A pecuniary loss which suffered by a single person, would very surely deter him from a repetition of the folly that incurred it, falls lightly and unheeded on a corporate purse. Disgrace which would drive any man of ordinary nerve out of society, when divided among a numerous body, falls in such infinitesimal portions to the lot of the individual members, as to be cared for by no one. The book of the last German propagandist we have named presents a case strikingly in point. It is such a book as we feel certain no individual publisher—no one especially who had ever made a German venture before—would have risked a shilling upon,—a book of huge bulk, but of such palpable foolishness as to be for its own merit's sake hopelessly unsaleable. Yet utterly worthless as it is, it happens to have found favour in the sight of the busy bodies of one of our amateur publishing Societies (the good sense of such busy bodies being generally on a par with their officiousness); and so because there is a stock purse to dip into, and many to share the credit or disgrace of the adventure, the book is, at great expense, and with much painstaking, translated, printed, published, and puffed.

Oken's work made its first appearance as far back as 1810, and would seem to have been reposing in a very decided state of oblivion, when about a year ago it came into the heads of the busy bodies alluded to, to drag it back once more to the light of day. Off they dispatch a missive complimentary to the author—still, by the kindness of nature, in the land of the living, and still, through the charitable forbearance of friends and neighbours, all at large—acquainting him with their wish to have translated his work, with his latest corrections and emendations, into English, and liberally offering to provide a translator of the first water, and to defray all the costs of paper and print. Thrice happy Oken to be thus agreeably awakened out of his long sleep of six-and-thirty years!—Rubbing his eyes, and throwing back his flowing hair, he takes up his pen and thus grace-

* "Physico-philosophy." By Lorenz Oken, M.D. From the German. By Alfred Tulk. Printed for the Ray Society. pp. 665, 8vo. London, 1847.

fully replies, "The intelligence of my 'Physico-philosophy' having been deemed worthy of translation *by so goodly and enlightened a Society*, cannot be otherwise than to me a source of delight."—*Translator's Preface.*

"Goodly and enlightened" forsooth! How truly so let the book itself attest. To enter into a grave examination of its contents would be a sheer waste of time and space; but we shall make a few extracts from it, which will speak significantly enough for themselves, without any comment:

Much of Nothing.

The highest mathematical idea, or the fundamental principle of all mathematics, is the zero = 0.

The whole science of mathematics depends upon zero. Zero alone determines the value in mathematics.

Zero is in itself nothing. Mathematics is based upon nothing, and, consequently, arises out of nothing.

Out of nothing, therefore, it is possible for something to arise; for mathematics, consisting of propositions, is a something in relation to 0. (P. 5.)

Something and Nothing the Same Thing.

The real and the ideal are one and the same, only under two kinds of form. The latter is the same under an indefinite, eternal, single form; but the real is also the same, yet under the form of quantity, and, as will be shown, of multiplicity. (P. 6.)

Zero, Plus, and Minus Proofs of the Christian Doctrine of the Trinity.

As the complete principle of mathematics consists of three ideas, so does also the primary principle of nature, or the Eternal. The primary principle of mathematics is 0; so soon, however, as it is actual, is it + and −; or the primary idea resolves itself in being at once into two ideas, each of which resembles the other in essence, but differs from it in form. Thus it is here one and the same essence under three forms, or three are one. Now that which holds good of mathematical principles, must hold good also of the principles of nature. The primary act is manifested, or operates under three forms, which correspond to the 0, + and −.

These three ideas of the Eternal are all equivalent to each other, are the same primary act, each of them being whole and undivided, but each otherwise posited. The positing primary act is the whole Eternal; the posited is likewise the whole Eternal, and that which is subtractive, retrogressive, combining the two first, is also the whole Eternal. Although all these ideas are equivalent to each other, still the positing idea ranks first, the posited second, and the combining third; yet, as if they had first arisen transversely (this is impossible, for they are coexistent; namely, before all time,) nor as if they occupied different positions (for they are everywhere;) but only according to their order and value. How one may be three, and three one, is thus rendered comprehensible only by mathematics. (P. 17.)

Nothing, of Two Sorts.

Viewed arithmetically, every position is a number; geometrically, however, it is a point. What the 0 is in arithmetic, the point is in geometry; the one the arithmetical, the other the geometrical nothing. Both sciences commence with nothing, and are only different views of nothing. The 0 is a temporal nothing (a number,) the point a spatial nothing (a figure.) (P. 27.)

Space only Nothing on a Large Scale.

Space is an idea, like time—*a form of God*, like time; it is the passive form, the extended 0 = + 0 −. (P. 28.)

Shape of Nothing on the Large Scale.

The sphere is nothing peculiar, nothing new in the thoughts of God, but only the point expanded, while this, again, is but a contracted sphere, just as the totality of numbers is an expanded 0, and this their contracted sphere.

Space is spherical, and, indeed, an infinite sphere. The sphere has been posited with space, and consequently from eternity; it is also an idea, and that, indeed, the total idea; for time and space have in it been posited together. (P. 29.)

A New Revelation.

For God to become real, he must appear under the form of the sphere. There is no other form for God. God manifesting is an infinite sphere. (P. 29.)

Magnetism a Cleftstick.

Magnetism is centropheric antagonism, a radial line, 0, — — $\underline{+}$, the action of the line being cleft at one extremity. Magnetism has its root in the beginning of creation. It is prophesied with time. (P. 31.)

Geometry only Solidified Arithmetic.

The doctrine of the sphere is *geometry:* for all forms are contained in the sphere. All geometrical proofs admit of being con-

ducted through the sphere. Geometry has originated directly from arithmetic, or is arithmetic itself, with this difference—that the latter regards series of numbers as individualities, the former, however, as a whole. Arithmetic is a geometry *serietas discretis*; geometry is an arithmetic *serietas continuiis*—a solidified arithmetic. (P. 34.)

Gravity, only weighty Nothing.

Gravity is not motion simply, but motion into a centre—into rest.

That which is itself in the very centre is, therefore, not heavy. *The primary act is not heavy.* Now as the sphere has originated out of nothing, so also has gravity originated out of the same. The form is a formed nothing; the form is, however, no form without internal forming force, and to this gravity belongs. The being of form and the being of gravity are one. Gravity is weighty nothing—a heavy essence, striving towards centre,—a realization of the first divine idea. Gravity cannot, therefore, be perceived in the universe as a whole, but only in its parts. (P. 36.)

Matter, only Gravity.

Points, which strive towards the centre are compressed, because they would all occupy one and the same spot. These points, however, are forces, which take up space, and therefore exclude other points. A space that excludes another is *matter*. Everything that has been said of gravity holds good in respect to matter; for matter is only another word for gravity. A heavy thing is a material thing. (P. 37.)

What would good old Ray, the patron saint (so to speak) of the Society under whose auspices this book has been translated—at once the most enlightened, the most rational, and the most pious of our older naturalists—have said to such transcendental nonsense as this? Have the "busy-bodies" no fears of a visit "in the glimpses of the moon" from Black Notley?—no dread of being taken to midnight task for so dishonouring the name of Ray as to connect it in any way with the resuscitation of such a compound of dreamy materialism, fantastical speculation, and empty jargon? The members of the Society should bestir themselves, and not allow the character of their body for respectability and usefulness to be again so jeopardized.

ON TWO EXERCISES GIVEN IN THE "HORÆ ALGEBRAICÆ." BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

1. *Diophantine Analysis.*

In the course of the "Horæ Algebraicæ" I have given two exercises. One of them is a Diophantine question, to the discussion of which I shall first proceed:

If in the equation*

$$x^3+y^3+z^3=w^3,$$

we substitute for x, y, z, and w their respective values in terms of a, b, m, n, and r, the result may be put under the form

$$Ar^3-Br^2+Cr=0$$

where

$$A=n^3-m^3-2$$
$$B=3b\,(n^2-m^2)$$
$$C=3b^2(n-m)-6a^2$$

Let $\quad C=0$

then $\quad a=\pm\sqrt{\dfrac{n-m}{2}}\times b\,\ldots\ldots\ldots\ (1.)$

and $\quad r=\dfrac{B}{A}=3b.\dfrac{n^2-m^2}{n^3-m^3-2}.$

In order that our results may be rational $\dfrac{n-m}{2}$ must be a square. Make

$$n=9 \text{ and } m=1,$$

then this condition is satisfied, and

$$r=\frac{240}{726}\,b=\frac{40}{121}\,b.$$

To avoid fractions let $b=121$, and in (1.) take the positive value of the radical: this will give

$$r=40,\ a=2b=242,$$

and consequently

$$\left.\begin{aligned} x&=a-r\ \ =202\\ y&=b-mr=\ 81\\ z&=nr-b\ =239\\ w&=a+r\ \ =282 \end{aligned}\right\}\ldots\ldots\ldots\ldots\ldots(2.)$$

So, if

$$n=8 \text{ and } m=0$$

we shall have

$$r=\frac{3\times 64}{510}\,b=\frac{32}{85}\,b,$$

let $b=85$, and in (1.) take, as before, the radical positively; then

$$r=32,\ a=2b=170, \text{ and}$$

$$\left\{\begin{matrix} x=138, & y=\ 85,\\ z=171, & w=202, \end{matrix}\right\}\ldots.(3.)$$

Now, by the aid of (2.) and (3.) respectively, we see that

* See *Mech. Mag.*, vol. xlvii., pp. 151, 152.

$$(202)^3 + (81)^3 + (239)^3 = (282)^3 \ldots (4.)$$

and $(138)^3 + (85)^3 + (171)^3 = (202)^3 \ldots (5.)$; hence, adding these two equations, omitting the term $(202)^3$ which will be common to both sides of the result, and arranging the other terms in order of magnitude, we have

$$(81)^3 + (85)^3 + (138)^3 + (171)^3 + (239)^3 = (282)^3.$$

The following verifies* this result:

$$\begin{aligned} (81)^3 &= 531441 \\ (85)^3 &= 614125 \\ (138)^3 &= 2628072 \\ (171)^3 &= 5000211 \\ (239)^3 &= 13651919 \\ \hline (282)^3 &= 22425768 \end{aligned}$$

Let p denote any rational quantity, then m being also any rational quantity, if we make

$$n = 2p^2 + m$$

we shall, in investigations like the foregoing, always arrive at rational results.

2. *On the First Exercise.*

[Vol. xlvii., pp. 14, 15, and 134, 135.]

In this Exercise, as at first proposed (vol. xlvii., pp. 14, 15,) there are two disposable quantities,—(1) the number of beasts purchased by each of the first two farmers, and (2) the number of beasts purchased by the third farmer—call these quantities x and z respectively. Then the question is an indeterminate one.

On modifying the exercise, and introducing an additional disposable quantity, y, as we have subsequently done, (vol. xlvii., pp. 134, 135,) we have seen that the question assumes a *mixed* character, being *determinate* so far as y is concerned, and *indeterminate* as to x and z. This, as well as a certain functional equation with which the question is connected, I have already adverted to, (*Ib.* p. 135,) and I would add, that the solution of the exercise shows incidentally, that *from the form of the expression*, the formula

$$x\,(x \pm 1) + 1$$

can never in all cases represent a prime number—which is, of course, known from far more general premises. The exercise was, in fact, somewhat inadvertently taken from some researches which I had made on prime numbers. I do not consider it deserving of the space it has occupied, but, it having appeared, I have thought it right to turn it to the best advantage.

2, Church-yard-court, Temple,
December 20, 1847.

* By means of the additional value

$$(202)^3 = 8242408$$

(4.) and (5.) may be verified separately. All these values are taken from Barlow's "Tables." (Lond. 1814.)

REMARKS ON THE MEANS FOR COMMUNICATING SIGNALS ON RAILWAYS.

Sir,—It appears to me that one of the greatest desiderata of the present day for the promotion of the safety of railway travelling, is the rapid and almost instantaneous means of effecting communication from one point of a train to another; of, in fact, conveying a distinct and unmistakable signal of alarm, whereby not a moment may be lost in securing the adoption of the only effectual course for the removal or diminution of the existing danger,—the stoppage of the train. Whether the public is to be invested with such a power of at once and in a direct manner giving the word of command to halt, on perceiving themselves on the point of being crushed to death or maimed for life, or whether they are to submit to the more circuitous course of first apprising the guard of their perilous condition, or of being, as at present, deprived of such power altogether, may be a question with some Engineers and Directors, but will not, I think, long remain so with the public.

The plan I have to propose is this:—Let a metal tube be carried along the side or top, as most convenient, of every carriage; at the anterior extremity, which must project through the head of the carriage, let there be attached about three yards of vulcanized caoutchouc tubing, which, when the carriage is not in use, might be conveniently inclosed in a case; let the free extremity of this flexible tube be armed with a brass moulding, admitting of accurate and instantaneous adjustment into a brass socket attached to the posterior extremity of the tube, which should issue from the back of the carriage, which is to be placed immediately in front of the former one; the parts composing this joint might be easily retained in position by a bayonet-fastening; thus the continuity of an acoustic tube would admit of being readily established along any length of carriages. Rising at a right angle from this tube, and descending into each carriage, and into each compartment of every carriage, when these are divided by distinct partitions, let there be a flexible tube of convenient length, terminating with a mouth-piece, which should communicate just above with

a powerful whistle; close behind the point at which this branch springs from the main tube, let there be a stop-cock or valve kept always open with a spring; let the orifice of each mouth-piece be protected with a cap, having a hinge-joint, so as to be instantaneously removable, but under ordinary circumstances closing the orifice. The tubular passage is, of course, to be continued from the last carriage to the engine, where it should terminate in a trumpet-mouth near the ear of the driver. Immediately over or by the side of each descending branch, there should be a direction of this nature: Damper alarum—"Remove the cap, close the tap or valve"—(either of which is so marked that a mistake cannot occur in the adjustment)—"Blow at the mouth-piece." Now as to the *modus operandi* of this apparatus:—A carriage is off the line,—there is a broken wheel or axle,—the flooring of the carriage is being torn up under the passengers' feet,—it is on a lofty embankment, on a viaduct, or in a tunnel,—the danger is imminent; not a moment is to be lost;—the mouth-piece is seized, and used as directed; no matter if a dozen employ it, the sound of that nearest the engine will reach its destination, the valve or stopcock being closed simultaneously with the exertion of the effort of blowing, it cannot take a backward course; every other mouth-piece anteriorly being also closed, it has no other vent than forwards to the orifice on the engine, where it issues in the moment of need.

It is obvious that this system is equally applicable for the announcement of the existence of danger to the guard, by the position of the stopcock or valve being reversed, and by the orifice of the tube being made to terminate in close proximity to his ear, instead of that of the driver: in this case, an additional system of tubes must be at the guard's disposal, and pass directly from him to the driver.

The various plans hitherto proposed for effecting communication between the guards and engine-drivers, and between the passengers and the latter, present these grave objections:—The continuous cord extending along the train, attached to a belt on the engine, admits, I think, of no general application; for, allowing two or three feet of it to intervene between every two carriages, (and this is the least that would be required to prevent its continually ringing the bell, owing to the action of the buffer-springs), were an accident to occur, perhaps the 18th of a mile from the guard he would require to pull perhaps 50 or 100 feet of cord before the bell could be sounded. The evil, too, of giving the guard credit for taking cognizance of every accident that may occur, at all hours, in all seasons, and under all circumstances, applies to this plan. The raising of red flags by day and coloured lamps by night, by the passengers through the roofs of the carriages, is impracticable if luggage is piled in mountains on passenger carriages, and would, too, involve the necessity for that penetration of vision which seems so generally acceded to the guard.

The conversational tube, of which so much has been recently said, is open to this objection—that unless some means similar to those I have proposed in my acoustic alarum be adopted, for directing the sound from the point where the danger exists to where the sound is intended to be conveyed, it would never be audible (Mr. Stephenson says, under no circumstances would it be so), and to sustain a deliberate conversation with the guard when danger is imminent—in which case only should any signalling be had recourse to—would be losing the precious moments on which limbs and lives might be dependent. It yet remains to be seen whether the electric telegraph be not too operose to be available on a moving train in cases of emergency.

Mr. Stephenson, in his letter to the Meeting of Mechanical Engineers held at Birmingham, states it as his opinion, after mentioning some of the numberless contrivances proposed for the like purpose, that "the most simple and effectual plan for ensuring the safety of the travelling public is this:—That two guards be placed on each train; one in the carriage next to the engine-driver, and the other on the last carriage but one, facing each other, and having a red flag to hold up by day, and a red lamp by night. If anything goes wrong, the signal could be immediately given, and by having a bell placed on the engine-tender, with a cord carried to the first guard, he could alarm the drivers by ringing the bell, without taking his eye from the other guard." Now, admitting that the eye of the guard can at all times perceive danger by daylight, and in a clear atmosphere, how is it to do so in the darkness of night, or even at noonday during a snow-storm, a heavy fall of rain, a dense fog, or in the black obscurity of a tunnel? The posterior guard may be a quarter of a mile from his *vis-à-vis*, and in a snow-storm, his red flag or coloured lamp would be rapidly covered, as Leitch Ritchie would say, "as with a shroud." Those who have had occasion to seek the *enlightened* disciples of Æsculapius by night, are well aware that their brilliant luminaries are often blushing unseen in the obscurity of an

envious winter fog, and it is not till within a near approach that the bulls' eyes, sparkling with emeralds, rubies, or sapphires, salute the dazzled retina of the messenger of Lucina. How, under such circumstances, is either of the guards to perceive anything going wrong at a few rods' distance—not to speak of a quarter of a mile —in time to prevent a catastrophe? As long as fogs prevail—as snow and hail storms, floods of rain, and pitchy dark nights, are common phenomena—and tunnels remain in black obscurity, all optical signalling on moving trains must be imperfect. The advantages which I consider the proposed acoustic-alarum would possess over both mechanical and optical modes of communication, are these:—It is on all occasions applicable, and if the direct means of advertising the engine-driver of the presence of danger be placed within the reach of travellers, the only step conducive to its removal can be taken with merely the delay of a few seconds: the engine-driver turns off the steam, his danger-whistle is sounded, the breaks are applied, and the train is stopped, I am told of the danger of investing the public with the power of stopping a train: another may be behind, and a worse accident occur than that for which the first is arrested: endless delays would happen from frivolous causes, &c. &c. It might sometimes be the case that the danger-signal would be given unnecessarily: but suppose it were, do not stoppages now frequently occur from hot wheels and other causes, and could not a light be always carried some distance behind the arrested train to avert the disaster of concussion? If a heavy penalty were imposed for employing the signal in any but cases of urgent danger,—those cases might even be defined:—it is hardly probable, I think, that such an abuse of a privilege for effecting their own salvation from impending destruction of life and limb, would be abused by the public. It needs but such another case as that on the Leeds and Manchester line, with the train a quarter of a mile in length, going at the rate of fifty or sixty miles an hour, the carriage getting off the line, or sustaining any other serious accident, being 40 feet long by 9 feet in width, and containing one hundred passengers,—such are the enormous dimensions to which these vehicles are now swelling; it needs but the frightful catastrophe to which such an occurrence must almost inevitably lead, to open the eyes of the public to the urgent necessity of the existence of some means within their reach in the moment of peril, of arresting the giant efforts of the monster-power by which they are being dragged headlong to destruction. I am, Sir, your constant Reader,

F. H. WALLER.

14, Harrington-square.

INQUIRIES AND ANSWERS TO INQUIRIES.

Employment of Magnetism as a Motive Power.—Will you be so good as to inform me through the *Mechanics' Magazine*, whether there was an engine constructed to work on the Edinburgh and Glasgow Railway the motive power of which was the attraction of the magnet. If there was one, what was the reason for abandoning the system?—I am, Sir, yours, &c., THOMAS DAVIS, Merthyr, Dec. 25, 1847.—In September, 1842, an electro-magnetic locomotive, invented by a Mr. Robert Davidson, was tried on the Edinburgh and Glasgow Railway; and this no doubt is what our correspondent has heard of. The success was very indifferent. A full account of the affair is given in our Journal of October 8, 1842, (No. 1000.)

Table of Logarithms.—A correspondent asks, "What is the best set of Logarithmic Tables of Numbers, Sines, Tangents and Natural Sines, &c. for Engineering and Surveying purposes?" We have no hesitation in saying, that Hutton is the book for him. The "Penny Cyclopædia and Supplement" contain two most elaborate articles,—TABLES from the pen of Professor de Morgan. In the first of these the author says of Hutton's Tables: "A very correct set, with sines, tangents, &c, and versed sines, complete, both natural and logarithmic. For those who want seven places, and can have but one book, there is none better." Babbage has logarithms of numbers only.

The Electric Light.—No apparatus for the production of electric light has yet been manufactured for sale. Mr. Staite, who has done the most to arrive at such a practical result, specifies next week some valuable improvements which he has made in the patent apparatus; and after that we presume we may hope to see the invention in full operation.

Right to make a Patent Apparatus for Private Use, and not for Sale.—"Will you be so kind as to inform me, through the medium of your valuable Journal, if there would be any danger in erecting an electric telegraph, *wholly of my own making*, on Cooke and Wheatstone's magnetic-needle plan, for a distance of about four hundred yards between my house and a workshop? It would not be used for profit, but merely for pleasure and for experiment. Do you really think I should be infringing on the patent rights, as the instruments I intend using would be wholly made by myself, on the same principle as Messrs. Cooke and Wheatstone's, only much simpler? Your Constant Subscriber, X X X." No doubt it would be an infringement. We recommend our correspondent to apply for a licence to the patentees. We dare say they will not be hard with him.

Extension of Patents.—We cannot better answer F. G.'s inquiries on this head than by the following quotation from the "Life of Watt," by Lord Brougham, who is himself a leading member of the Privy Council:—"The course which a patentee ought to pursue, if there be no opposition to his claim of extension, is to employ no solicitor and no counsel, but to appear in person before the Judicial Committee, as my gallant and truly ingenious friend Lord Dundonald (better known as Lord Cochrane) lately did. Their Lordships always favour such a course, the rather as they thus obtain the advantage of hearing the explanations required from the person best able to give them. In opposing cases, professional aid is requisite."

Erratum.—In Mr. Rock's article last week, p. 625, col. 1, for "*un*interrupted vibration," read "*inter*rupted vibration." It is the vibration from one side meeting that from the opposite side which, in Mr. Rock's opinion, produces the effect.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 29	1303	Henry Reshton	Kendal, Plumber	Improved sheet or glass-frame for vineries, &c.
30	1304	J. Norrington	Plymouth	Stock.

Advertisements.

CONTENTS OF THIS NUMBER.

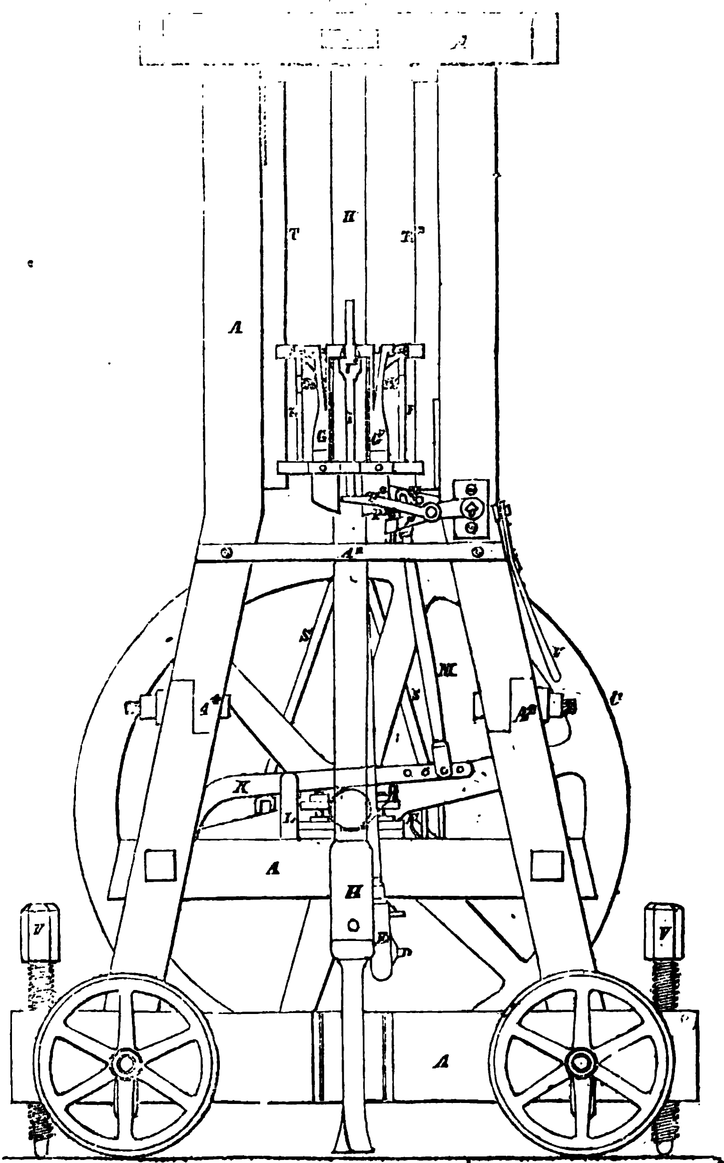
LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1274.] SATURDAY, JANUARY 8, 1848. [Price 3*d*., Stamped, 4*d*.
Edited by J. C. Robertson, 166 Fleet-street.

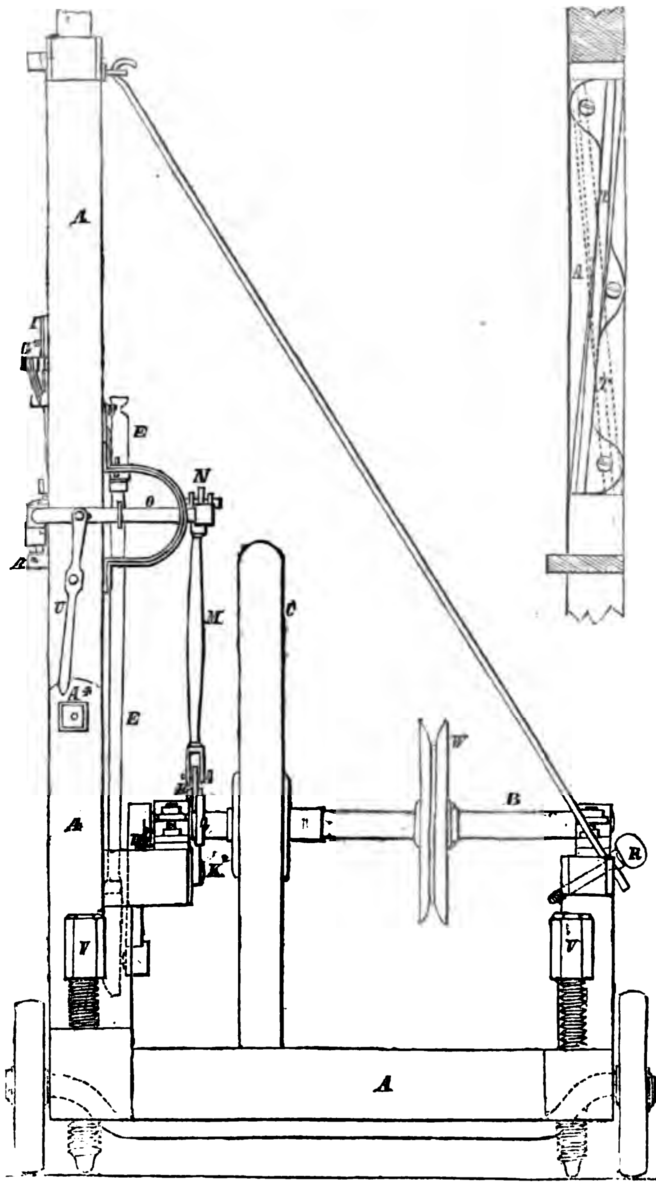
NICHOLSON'S IMPROVED STONE CUTTING-MACHINE.

Fig. 1



NICHOLSON'S IMPROVED STONE DRILLING-MACHINE.

Fig. 2. Fig. 3.



SIR,—I forward to you a description and drawings of a stone drilling-machine, lately introduced into this country by me. It is now in use in several parts of England, and has been found to facilitate the process of excavating rock very much, and only requires to be known to be in general use. The machine is made at

the Shildan Engine Works, near Darlington.

I am, Sir, your obedient servant,
EDWARD NICHOLSON.

Holdforth-house, Bp. Auckland, Dec. 14, 1847.

Description.

Fig. 1, is a front elevation of the machine; fig. 2, a side elevation; and fig. 3, a sectional side elevation of part of the framework, showing the slide, T, and also, in dotted lines, the slide T^2. A, is the framework of the machine; B, the driving shaft; C, fly-wheel; D, crank on the shaft, A B; E, connecting rod attached at its lower end to the crank, D, and at its upper end to the carriage, F, which is alternately raised and lowered thereby; this carriage supports the levers G G^2, working on fulcra at * *; the lower ends of these levers form jaws, which (when the upper ends are distended or pushed away from each other,) clip the drill, H, whereby the drill is raised along with the levers, and the carriage, F. I, a tappet, or rod, furnished at I^2, with inclined surfaces, which, when the rod is forced upwards, push the upper ends of the levers, G G^2, away from each other, and thereby effect the "clipping" referred to. K, a bent lever which works at one end on a fulcrum at K^2, and through a guide-fork L, is attached at its other end to a rod, M, which connects it with a lever, N, made fast to one end of the rod or shaft, O, as is also the lever, P, to its other end. The lever, P, is furnished with an arm, P^2, which is jointed thereto at one end, while its other end rests upon a screw, P^3, by which its action is regulated. Q, is a cam on the shaft, B, so shaped and situated as to raise the lever, K, at or about the time when the crank, D, is at the lower end of its two null points, by means of the intermediate parts, M N, O, P. The lever, K, raises the end of the arm, P^2, before (or quicker,) than the carriage, F, and presses the tappet, or rod, I, upwards, whereby (as before described) the jaws of the levers, G G^2, are made to clip and raise the drill, H, with them. Just before the crank, D, is at the higher of its null points, the top of the tappet, or rod, I, strikes against the piece, Q, fixed to the framework, and thereby disengages the drill, which falls in the direction given to it by the guide-piece, A^2, of the framework and the guide-rollers, A^3, A^3; which direction is regulated by screws, R, which fasten the rod, S, so as to hold the upper part of the framework from the joints, A^4 A^4, at any angle at which the drill may be required to work. The carriage, F, has grooves which work on the slides, T T^2; and being shaped and placed "on the skew," and slanting in opposite directions, give to it, and with it, to the drill also, a slight or partial rotary motion when in the act of being raised, so that the edge of the drill may be presented in a continually altering position upon the ground or work on which it operates. U, is a lever for sliding the shaft, or rod, O, laterally, and thereby throwing the arm, P^2, out of gear with the tappet, I, when required. V V V V, are screws passing through nuts embedded in the corners of the frame, for the purpose of adjusting it to the inequality of the surface on which it may be required to stand. W, driving pulley with grooved periphery for rope.

ON VAPORISATION, (IN CONTINUATION OF THE ARTICLES ON "THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.")

The conversion of liquids into gases by heat, as exhibited either in the slow evaporation of nearly all fluids at common temperatures, or in the production of gases having great pressure with or without the appearance of boiling—is a subject treated of by such a number of first-rate men, and on the illustration of which such a mass of experiment and observation has been heaped up, that it is evident we must attribute the very imperfect and unsatisfactory state in which, after all, it still remains, to the extreme difficulty of the subject itself. In fact, we have in this, as in so many other branches of physics, arrived at a point where conjectures and hypotheses on the nature of molecular forces are all that is left to us —where direct observation ceases, and the phenomena whose agency we are desirous of tracing are altogether beyond the limits of our senses. We have got on one side an innumerable crowd of every-day facts, such as the boiling of a tea-kettle, or the drying of clothes after washing, which we hardly ever think worth inquiring into at all—and on the other hand, a few accidentally-observed facts, which we call "curious," and having put them into a magazine, and

wondered at them very much, as usual, we forget all about them too. To any one, however, who wishes to test any theory he may have formed by fact, these curiosities stowed away in old magazines, and altogether lost, are of the greatest value. One of the chief objects in this paper is to induce those who may read it, and who are interested in the subject, to be on the look-out for these sort of facts, and of which it is extremely probable that nearly every person engaged in manufactures, &c., could supply some. The experiment of Mr. Coathupe, which will be mentioned in the course of the next paper, may be taken as an example.

A recent German experimenter, Magnus, concludes one of his articles with the following sentence:—"There does not exist an older physical experiment, nor one more frequently repeated, than that of boiling water; but, nevertheless, what occurs in the process was not sufficiently known, and even now much still remains unexplained." As the clearest description of this process which I have met with in any of the popular treatises, I shall translate here that given by Pouillet in his *Elément de Physique*:—"When the ebullition of a liquid is observed, in general nothing is seen excepting a movement, more or less rapid, which mingles together the whole mass, and agitates it in every direction; but when the experiment is made in a glass vessel, we perceive the continually-varying cause producing these motions. Bubbles of vapour are seen to be formed on the heated sides of the vessel, which bubbles rise in consequence of their lightness, and burst on arriving at the surface. At the moment of their formation they are small, but grow larger as they ascend; and those which proceed from the hottest parts of the vessel are those which succeed each other with the greatest rapidity. In order that these bubbles may be capable of existing and ascending in the midst of the liquid mass which presses upon them on all sides, it is obviously necessary that the vapour composing them be of a tension equal to the surrounding pressure. This it is which determines the boiling point of different liquids, and also that of the same liquid when submitted to different pressures. Hence the first condition for boiling is, that the temperature be sufficiently high to enable the elastic force of the vapour to overcome all the pressures which are being exerted in the liquid mass. The second condition is, as we have already seen, that the vapour be supplied with that latent heat which is essential to its formation."

In order to obtain anything like a comprehensive view of the general nature of vaporisation, under all its varied modifications, we must consider it as a mechanical problem. In every drop of water converted into steam, we have a contest of opposing forces. Let us take an example, and go through it, step by step. In the first place, then, let us suppose the water to be perfectly pure, and placed in a metallic vessel over a fire, and under the ordinary atmospheric pressure. We must consider what happens to each of the indefinitely small particles of which the whole mass of water is made up. There are many reasons which induce us to consider these small particles to be of a spherical form; there must, at any rate, be innumerable interstices or spaces unoccupied by the watery particles throughout the mass. Each of these small spheres most probably consists of a number of still smaller particles of water, and each of the *ultimate* particles of *water* is again composed of particles of oxygen and hydrogen. At present, however, we need not trouble ourselves with these latter, or with the still simpler molecules into which it is possible that both oxygen and hydrogen may be decomposed. In all the ordinary phenomena, we have merely a change of state from the larger compound *water*-particle into the smaller and less compound *vapour*-particle. This partial disintegration is effected by heat, and if we were, in any experiment, to go on applying heat to the vapour-particles, we should still further decompose them into their simpler elements of oxygen and hydrogen. From solid to liquid, from liquid to vapour, and from vapour or compound gas to the constituent gases, oxygen and hydrogen, we see only one uniform process of decomposition: from the more compound system, the individual elements of which are held together by mutual attractions, we get, by the application of heat, to the less compound system; whose individual elements seem, however, to have a still more powerful attraction for each other—and

from this to a still simpler system, having yet stronger internal forces. Each of these compound systems we nevertheless in common language call a *particle*: thus if we take up on the point of a needle a mass of water, and, if possible, divide that into still minuter portions until mechanical agency can reach no further, so that the ultimate mass arrived at is only capable of still further decomposition by the agency of heat—we may give to this the name of a particle of water. Every particle of water, then, W, consists of a number of particles of vapour, each of which we shall call, V, all of which, whilst in the liquid state, are bound together by strong mutual attractions. Let us consider one of the water particles, W, as it exists in the midst of the surrounding fluid. It is a system of particles acted on by internal and also by external forces. Amongst these latter we have (1) the pressure of the atmosphere transmitted by the surrounding mass of water, and (2) the weight of the superjacent column of water reaching to the free surface of the fluid. All these forces must be overcome by the agency of the heat before the vapour particles, V, can burst their bonds and assume an independent existence. The common books on physics give abundant illustrations of the influence of these external forces—and some of them are laughable enough; as, for instance, the astonishment of a traveller, who after a toilsome ascent of a lofty mountain, being desirous of a cup of tea, put his kettle on the fire forthwith, and was rejoiced at seeing *how soon it boiled.* "All is not hot that boils." His tea was little better than lukewarm, and do all he could, though he found it easy enough to "get up the *steam*," to make the water *hot* he found was quite a different thing, and not to be effected without several more pounds per square inch of atmospheric pressure than was to be had in that region. If his kettle lid had been tight, however, and he had thought of blocking up the spout, he might have made the water as hot as he liked. For a similar reason, it would require more heat to make a certain quantity of water boil in a long narrow tube (the fire being applied at one end) than if the same quantity were exposed to the fire in a broad shallow dish.

The influence of *these* external circumstances is, then, so far, well understood. There still remain, however, a great many very intricate questions to be answered as to the actual process by which the originally fluid particle becomes converted into a number of vapour-particles; to say nothing about the equally difficult question as to how the heat is propagated through the successive layers of fluid, from bottom to top. And in the first place, with regard to the influence of the pressure exerted on the surface of the fluid, either by the atmosphere or confined vapour, all that is shown by the popular illustrations just alluded to is, that the water cannot be heated beyond a certain degree of temperature dependent on the pressure at the surface—and that according as this pressure is greater or less, the greater or less will be the *temperature* at which the phenomenon called boiling occurs. Our popular treatises amplify quite enough on this point, but we must inquire much more fully into the various other circumstances accompanying the variation of pressure before we can be said to understand much about the thing. The mere circumstance of "boiling" is of comparatively little importance. That which is of most importance, both in an economical and theoretical interest, to learn, is the connection between the following quantities:

1. The amount of heat supplied in a given time.
2. The quantity of water changed into steam by this heat.
3. The pressure and other physical properties of this steam at any given instant.
4. The corresponding *temperatures*, as indicated by mercurial thermometers immersed in the water and in the steam.
5. Atmospheric, or other pressure exerted on the surface of the water.

It is astonishing how very little has been really done, notwithstanding the immense number of experiments made by so many first-rate observers; how little, I mean, capable of giving any insight into the whole physical process. The chief object aimed at in nearly all these experiments, has been the formation of tables giving the temperatures and corresponding pressures. Everything that relates to the quantity of heat supplied, the time elapsed between any one given pressure and temperature to an-

other, the actual amount of water vaporised, &c., &c., is wholly omitted. If such tables enable a man in charge of an engine to say at once what the actual pressure of the steam in the boiler is by looking at the thermometer immersed in the water or steam, they are of course of the greatest practical utility—and yet, nevertheless, this may be but a very imperfect contribution towards a thorough knowledge of the whole process. Moreover, with regard to those few experiments which have had reference to the other questions above mentioned, I have found that unless the original account by the experimenters themselves be consulted, no reliance whatever can be placed on the propositions which later writers have thought fit to announce as the result of such experiments—and, indeed, in some cases it is altogether impossible to say what is the exact meaning intended to be conveyed by the writers. For example, Dr. Lardner, in his "Treatise on Heat," (and thence copied into his "Treatise on the Steam-engine,") says, that it results from experiment; "that the same quantity of heat is necessary to convert a given weight of water into steam, at whatever temperature, or under whatever pressure, the water may be boiled." The experiment referred to is no doubt that of Watt, which I will now transcribe in his own words. (Note to article on Steam-engine, in Robison's "Mech. Philos.") "When the digester was set upon a steady fire for a given time, half an hour for instance, the steam being allowed to issue freely by keeping the safety-valve quite *open*, and the quantity of water evaporated in that time being ascertained; if the digester was again placed on the fire, and continued for an equal time with the safety-valve *shut*, upon opening that valve a quantity of steam would issue with violence; and when the elasticity of the steam issuing was reduced to that of the atmosphere, I found the quantity of water evaporated in these circumstances was apparently the same as had evaporated in an equal time when the valve was constantly open. From whence I concluded, that the quantities of water evaporated in any given time were proportional to the quantity of heat which entered it, *et cæteris paribus*, to the surfaces exposed to the fire and not to the surfaces exposed to the air, as had been supposed, and as is the case where the air is the sole agent of evaporation in heats below boiling."

It requires but very little consideration to see that this experiment does not at all prove that "the same quantity of heat is necessary to convert a given weight of water into steam at whatever temperature, or under whatever pressure the water may be boiled." For this simple reason—the amount of water converted into steam was only measured after the pressure had been reduced by the opening of the valve to the ordinary atmospheric pressure. If the water had been contained in a glass vessel, so that the quantity vaporised could be ascertained without altering the pressure on the surface, and if in this way it had been found that the same quantity was converted into steam in half an hour as under the usual pressure of the atmosphere, then indeed it would be proved that the same quantity of water is vaporised by a given amount of heat, whatever be the pressure under which it is produced. But in the experiment as described by Watt, there might, for anything we know, be an immense alteration in the rate of vaporisation at the instant of opening the valve. It is possible, certainly, that this is not the experiment referred to by Lardner; but from the preceding references in the Treatise, I have no doubt that it is to this that he refers, and at any rate I have not met with any other experiment from which any such conclusion has been attempted to be drawn.

Another source of frequent annoyance to the reader is, that in many of the recorded experiments where it is absolutely necessary to know the *quantities of heat* employed to produce the effect mentioned, the writers have contented themselves with giving merely the *temperatures*. The thermometer has been relied upon far too much, and men are only now beginning to see the fallacies into which it may lead. The expansion of mercury is (as of course every body *acknowledges* verbally,) merely one of the effects of heat which is often useful as an indicator of other concomitant effects; but though thus verbally acknowledged the fact is frequently forgotten in practice. It cannot be too strongly or frequently urged upon experimenters, that no one of the effects produced by any physical agent

can be relied upon as the accurate *measure* of the primary cause, unless *all the other accompanying circumstances are precisely the same.* Those who have given any attention to the subject of voltaic electricity must have noticed the great difference and inexplicable contradiction between different experimental results, all depending on the use of the deflection of a magnetic needle as a *mathematical measure,* when compared with the results given by the heating of wires, decomposition of water, expenditure of zinc, &c., &c., when these latter effects are taken as the measures. It is in vain to expect any correct views of the nature of these physical agents until a great deal more of mathematical accuracy is introduced into the *method and principles* of measuring: accuracy in the *degree,* though so exclusively attended to by experimenters, is a very far inferior subject;—what I mean is, that an error of a few degrees in the thermometric and galvanometer needle results, is of much less consequence than the reliance on these two instruments as indicators of a primary force under doubtful circumstances. It is very possible that such a blind trust may be productive of no error throughout a large class of experiments, and yet be utterly fatal in another class. Suppose, for instance, a person ignorant of the principles of mechanics were to set about measuring and comparing the force of the earth's attraction at different distances, and suppose that he relied entirely on the *velocity produced in a given time,* without any reference to the *mass* acted on, as a correct representative of that primary force he was seeking to measure. He would arrive at correct results, notwithstanding his blind confidence in a wrong principle. Why? Because *it so happens* in this particular class of facts, that the force of the earth's attraction (measured by the acceleration produced in a given time,) is altogether *independent* of the mass of the attracted body. But now let this blind experimenter turn to a different class of experiments and try to measure the relative *weight* of bodies at different distances from the attracting body, and here he would make the most outrageous blunders if he continued to rely as before on the acceleration produced as the only measure. Or, again, if he were to trust to the same measure in estimating the effect of an impact, the elasticity of a spring, &c., &c., in every such case, by relying on the acceleration produced in a given time as the only measure, and leaving out of consideration the *mass* in which that acceleration was produced, he would be led to the most erroneous conclusions. Now, so it may be with regard to the two great instruments on which almost every experimenter is now so confidently relying. And until the connection and exact mathematical relation has been discovered between the different effects of the force we are seeking to measure—(just as in mechanics, the relation between the pressure, acceleration, and mass are given)—until then, we must have *all* the different effects and *all* the accompanying circumstances fully and clearly stated in every experiment, before it can be of any use in forming a general theory. It is not at all sufficient to say that the *temperature* of a fluid is so and so, and the pressure of its steam so much: we must know the quantity of heat (by which phrase, of course, is meant the *relative* amount, as concluded from the *time* during which a uniform source of heat is applied, &c., for it is never with *absolute* quantities that we are concerned in any branch of physical inquiry, but only with *relative* ones,) *the whole circumstances,* in short, of the experiment. In a voltaic experiment we must have given not merely the deflection of the needle, but the amount of zinc and copper expended, the size of the plates, the strength of the acid, the length, &c., of the wires,—everything which can in any way have any influence on the other effects; and indeed this is done much more carefully in this subject than in the immediate subject of this paper.—(*To be continued.*)

THE LAW OF ATMOSPHERIC RESISTANCE.

Mr. Editor,—In the monthly part of your valuable Magazine for 1st November last, I notice a communication from Professor Davies on the subject of atmospheric resistance. After having been engaged at intervals for more than fifteen years, in both the practical as well as the theoretical investigation of this problem, I have lately had the satisfaction of bringing my labours to a conclusion, by the discovery of what I conceive will be found to be a correct solution. I am

not aware that my theory in any way interferes with Professor Davies's formula, and therefore do not now write to you on that account, but simply that, as it appears there are others in the field investigating the same subject, I am desirous that the result of my own labours should be made public. With this view, I give below the formulæ, in which the results of the theory are embraced.

The first of these formulæ relates to what may be termed *slow* motions, and the second to rapid motions, such as military projectiles. It will be seen, however, further on, that the two are not necessarily distinct.

The atmosphere is, of course, supposed to be homogeneous; the case being assumed to be that of a thin plane, moving through it in a line perpendicular to its surface.

Let v = feet per second velocity of the plane, and p = pounds averdupois per square inch, the resistance which the plane meets with from the atmosphere (to be found.)

$$\text{Then will } p = \frac{14.7279 \times \overline{27,864.7 + h}}{27,864.7} - \frac{14.7279 \times 27,864.7}{27,864.7 + h}.$$

$$\text{Where } h \text{ is to be taken} = \left(\frac{v}{8.0247}\right)^2; \ 8,0247 \text{ being} = \sqrt{64.395}.$$

The number 64.395 being taken at $2g$, that is, twice the force of gravity, h is consequently the height due to the velocity with which the plane moves through the atmosphere.

Likewise, 14.7279 = lbs. per square inch pressure of the atmosphere, and 27,864.7 = feet height of the atmosphere, supposing it to be of equal density throughout, = about 5¼ miles.

The two last numbers are calculated on the supposition that the barometer stands at 30 inches, and the thermometer at 60° Fahrenheit. The specific gravity of mercury being taken at 13.598, and the specific gravity of atmospheric air at .00122, water being 1.

The specific gravity of atmospheric air here given being that of anhydrous air, as determined by Biot, will be rather greater than what will naturally occur under the circumstances of the pressure and temperature assumed above, and consequently the formula may be expected to give a (rather) greater degree of resistance than what is indicated by experiment.

In other respects also, any error in the data assumed, will, of course, occasion a corresponding error in the result of the formula.

It may, perhaps, be well to repeat that the formula applies only to the case of a *thin* plane, and will not answer for the case of a solid body of any considerable thickness. For instance, a cube moving through the atmosphere in a line perpendicular to one of its faces, will meet with much less resistance than a thin plane moving with the same velocity, whose area is equal to the area of one of the faces of the cube.

When the plane, however, moves through the atmosphere with considerable velocity, it is obvious that the air immediately in the front of it will be compressed in proportion to the pressure or resistance which the plane meets with. This circumstance necessitates the introduction of another term into the formula, which, for the sake of convenience, may be put under the following form, viz.:

$$p = m \times \sqrt{\frac{m}{14.7279}} - n.$$

$$\text{Where } m = \frac{14.7279 \times \overline{27,864.7 + h}}{27,864.7}.$$

$$\text{And } n = \frac{14.7279 \times 27,864.7}{27,864.7 + h}.$$

The numbers, &c., being the same as before.

It is to be observed, that in slow motions, the term

$$\sqrt{\frac{m}{14.7279}}$$

will not differ materially from 1, and may, therefore, in those cases, be safely neglected. In this case, the formula becomes the same as that previously given.

In calculating the resistance to military projectiles from this formula, it will, of course, be necessary to make a proper allowance for the figure of the shot; and if great precision is required, two or three corrections will likewise be necessary; the causes of which are not embraced in the theory, which is built, as will be seen, entirely on the mechanical properties of atmospheric air.

With respect to the corrections here alluded to, they may perhaps form the subject of a few remarks in a future communication, if the present one should be fortunate enough to meet with the approbation of yourself and the public. Respecting the demonstration of the theory on which the formulæ here given are grounded, I have been intending for some time to put it in a proper form for publication as soon as leisure will permit, but which, I am afraid, will not occur for some time to come.

The formulæ would have shown more clearly perhaps the nature of the theory, had one or two terms not been eliminated from them in the process of reduction; but as they are, I shall be greatly obliged by your giving them an early place in your pages. I am, Sir, yours, &c.,

JOHN POTTER.

Chorlton-on-Medlock,
Dec. 23, 1847.

THE CAUSES AND EFFECTS OF EXPLOSIONS IN STEAM ENGINES INVESTIGATED; AND THEIR RESULT FROM AN EXPLOSIVE PRINCIPLE DIFFERENT FROM THE FORCE OF ELASTIC STEAM DEMONSTRATED; WITH AN EASY AND CERTAIN MEANS OF PREVENTING ITS DESTRUCTIVE EFFECTS, AND REDUCING IN GREAT PART THE ENORMOUS WEIGHT OF ENGINES. BY JOHN WILDER, NEW YORK.

(Continued from page 17.)

Mr. Howard, who prepared an explosive compound from a solution of mercury in nitric acid, found by repeated trials, that ten grains of the compound produced by explosion four cubic inches of gas; but having burst open and destroyed a very strong gun by the explosion of thirty-four grains of the compound, and sensible of the absurdity of attributing the effect to the 14 cubic inches of gas produced, he assigns the reduction and expansion of a part of the mercury by heat as the cause. He then informs us that he had frequently fired the explosive compound without burning gunpowder intermingled therewith, which he ascribes to the quickness of the explosive action; and singularly enough, the similar explosion of gun-cotton without burning gunpowder intermixed, has been generally attributed to the same cause; yet it is universally known that gunpowder is readily fired by electricity. Wherefore, we must assume that the velocity of explosive action is greater than that of electricity, or admit that a very high temperature is not essential to explosive action—conclusions incompatible with the properties or the action of gas as an explosive agent.

We are informed on high authority that gun-cotton may, by careful preparation, be made to exceed six times its weight of gunpowder in explosive violence, nevertheless it does not evolve a greater volume of gas than an equal weight of gunpowder.

The violent explosions of fulminating gold and silver have been long known. So great is their violence, that it is deemed dangerous in the extreme to operate on these compounds without the greatest care, or on more than one or at most two grains; yet the sole known products of these explosions, are the metal in a state of reduction and nitrous gas of thrice the density of atmospheric air.

Notwithstanding the violence of these explosions, the amount of sensible heat evolved is too small to afford the least ground for ascribing the effects to a high temperature and the amount of gas evolved and expanded. The detonations of certain compounds of azote and chlorine, or azote and iodine, are equally violent; yet the sole products are azote and chlorine, or azote and iodine, at so low a temperature and in such small amount as to preclude the idea that the sole or even chief causes of explosive action are the amount of gas produced, and its farther expansion by the heat evolved. But as in every known instance of explosive action there is a concurrent decomposition of the explosive compound, the conclusion is not to be avoided that an explosive power is set free.

Caloric and water, or its vapour, are not known to combine except through the medium of sensible heat; nor can they be kept in combination above the temperature and pressure of the atmosphere, except in close and strong vessels and under compression; and the elastic force imparted to steam or vapour, by caloric, is always measured by the compressing force: hence the escape of caloric from its combination with steam, or vapour, must instantly follow the withdrawal of the compressing force. If, therefore, vapour at a high temperature and of great force (as strong steam) be confined in part of a strong and close vessel (a long engine boiler for instance), and it be instantly opened towards the other part, it is evident that on the removal of the compressing force, caloric from its great velocity compared with that of steam or vapour, must escape instantaneously from its combination therewith, but it does not escape from the vessel, which remains closed, except by its own inherent power and in a manner not well

understood. There is nothing to warrant the idea that it ceases to exist, or that it recombines with the vapour it had quitted.

If a gun having a full load of powder only, be held upright and fired, the gun remains unharmed; if it be again loaded with an equal charge, and a cork be fitted in the muzzle accurately but not tightly, and the gun be then held upright and fired, it will certainly burst; nevertheless, it is plain that the initial force of the fired powder is the same in both cases; nor does the cork offer any mechanical resistance to the escape of the liberated gas which can be appreciated; but it evidently prevents the escape of the caloric which has given up its combination with the gas, and it is to the action of this subtile and dangerous element when set free that we refer the effects produced.

The capacity of the valve chamber, together with the clearance or space between the piston and the end of the cylinder of an engine, is often four-hundredths of the cylinder itself; it is obvious, therefore, that when the steam valve is opened, the steam which first passes into the valve chamber will have free space to expand, and will be under but slight compression; of consequence caloric must escape from its combination with the steam, and in large amount if the temperature be high. But there is no outlet for its escape, nor can it be absorbed in heating the metal in which it is enclosed, since that has become already as hot as the steam in the boiler; there may even be a degree of repulsion; nor is caloric ever known to remain isolated; and it is from analogy and the effects produced only that we can infer its real nature.

By the conversion of water into aqueous vapour, clouds are formed replete with electric fire. It is certain that atmospheric air is present, but it offers no resistance to the passage of the electric and elementary fires, that has been appreciated, and the extent of its agency is not known; nor do we well understand the manner in which the electric force is exerted, but its effects are evident enough.

I saw, several years ago, the remains of a large and very tough and knotty pasture oak, which had been riven by lightning from its top to the ground, and strewed in pieces on the field. The effects were manifest, but how so great an internal force as that which could cleave the solid oak in fragments from its centre, should be put in action by an apparently external cause, I was wholly unable to comprehend.

It is well known that the constituents which go to the formation of water, have always the same relative proportions to each other; and, when at the temperature and pressure of the atmosphere water combines with elementary heat and forms aqueous vapour, proportions equally definite obtain; and steam differs from aqueous vapour chiefly by its greater amount of heat, and consequent greater expansive force; but these are retained in combination only by compression, and in close vessels. When elementary heat combines with water, and forms aqueous vapour, it ascends into the atmosphere because its specific gravity is much less than that of air, and it is equally elastic and expansible; but the height to which it reaches is obviously limited, and does not differ much from that at which animal life ceases to be sustained. And the dryness of the air on the tops of high mountains has been often observed—the most deliquescent salts remaining unchanged for a long time. It is also well known that much more rain falls in valleys than on the adjacent hills, although the thermometer shows but a slight difference of temperature. There is therefore an effective and universal cause, independent of temperature, which prevents the ascending to great height of aqueous and other vapours, some of which remain permanent under any known degree of cold, and cannot, therefore, owe their reduction to their original elements to a low temperature.

There are recorded instances of severe lightning and thunder, when there was not the least appearance of clouds, although of very unfrequent occurrence; but to such cases the charging of clouds with electricity, and its liberation by attraction or repulsion, is of very difficult application. Nor is it easy to understand how clouds can become charged with electricity, except by its combination with the constituents, since the attraction of the earth is too strong for the electric fluid to remain isolated above the surface; but the combination of elementary heat with water, and the consequent formation of aqueous vapour which rises in the atmosphere, because its specific gravity is less than that of air, and the formation of clouds from vapour is at all times going on.

When clouds are formed from the vapour, they are often charged (as it is termed) with electricity, from which heat and light are given off; and these are the known constituents of fire, the great agent in the production of steam; and the boilers of steam engines, in which is only water and steam produced from water by the action of fire, have been sometimes rent asunder endwise, which has been demonstrated to require double the force which would burst them open laterally, and therefore could not have been effected by the force of steam, but must have been the result of a power which has no parallel except in the lightning.

Under the same temperature the specific gravity of vapour of water is to that of atmospheric air as 625 to 1000, and as they are equally elastic and expansible, it might be supposed that the vapour of water immediately on its liberation would ascend into the upper regions of the atmosphere; but this is not the case, for clouds are never seen of the altitude of the highest mountains, which cannot be the effect solely of a low temperature, for the proportion of cloudy weather is greater in winter than in summer, notwithstanding a difference of temperature at times equal to an hundred degrees of the thermometer, and much exceeding the difference between the heat and cold at the base of mountains and at the line of perpetual snow; at which height thunder storms have not been observed; besides, persons on mountains of secondary height have seen fogs near the summit descend to a much lower level, and then move horizontally with all the phenomena of thunder storms, which shows conclusively that they are but in part the result of a low temperature.

It is obviously incompatible with the necessity for rain to water the earth, and the variations of temperature and seasons requisite to vegetation and production, that the conversion of aqueous vapour into rain should depend solely on a low temperature.

It is well known that caloric, combined with vapour under a pressure greater than that of the atmosphere, is wholly given off the instant the pressure is removed; and it is thence apparent, that when the vapour of water ascends into the atmosphere its caloric must lessen as the pressure lessens, until a height is reached at which the combination of caloric and water ceases, and they return to the earth in the state they existed previous to combination. That they do not return in a state of combination is evident; for the attraction which was insufficient to keep them at the surface of the earth, becomes less and less as the height above the earth becomes greater. We cannot therefore admit that the elementary and electric fires, in a state of isolation, overcome the greater attraction at the surface of the earth to ascend into the atmosphere, and return to the earth again in consequence of a less attraction.

In every state in which the electric fluid has been observed, it has been attracted towards the earth with a force which is proved to be very great, by the velocity of the fluid and the effects produced in its passage to the earth. It is therefore manifest that it cannot leave the earth except in a state of change or combination. Caloric combines with water and forms vapour, which is not decomposed by the extreme cold of winter, since it is often "too cold to snow;" it has but five-eighths of the specific gravity of atmospheric air, and is equally elastic and expansible; it must, therefore, immediately on its formation, ascend to a greater height than has yet been observed, if it was not checked by some uniformly acting cause, independent of temperature; and the only known cause adequate to the effect, is the deficiency of the compressing force requisite to the continuance of the combination, and this in consequence of the lessening of the atmospheric pressure, as the height above the earth increases. Hence we infer that caloric and water do not remain in combination in the form of vapour at a less atmospheric pressure than is due to 15 or 18 inches height of the barometer, as clouds are not observed above a corresponding altitude, and when a height is reached at which the combination ceases, the imponderable caloric returns to the earth in consequence of an attraction no longer counterbalanced by the density of the atmosphere, and the water descends of its gravity, in the form of rain, dew, snow, as the case may be.

Sound has been found, by careful observation, to move with a velocity of 1,140 feet the second; hence we may, by observing the flash of lightning and the time in which it is followed by thunder and its duration, approximate to the distance of an electrical discharge; but thunder often follows lightning instantaneously, and with a report of such short duration as to prove the discharge to have taken place near the earth, and, of consequence, at the same temperature as at the surface. Nevertheless it is not to be doubted that the liberation of the electric fluid is effected by the same causes, at whatever distance from the earth's surface it may take place.

It is the universal law of elastic fluids, to which there is no exception, that their pressures are exerted equally in every direction, and therefore, within a close vessel (a boiler for instance) the pressure of steam is equal on equal surfaces. Hence within a cylindrical boiler the pressure of steam on the ends is equal, but this pressure is sustained by the whole ring or circumference of the boiler, which joins the ends equally in all parts of the periphery; but the lateral pressure on an equal surface is sustained by two portions of the circumference, each one-fourth thereof in length, and therefore half only of the amount of metal which sustains an equal pressure on the ends. Hence it is impossible that a cylindrical boiler should part asunder endwise from the direct force of steam, as has been proved.

It is equally impossible that a cylindrical boiler should be moved endwise by the force of steam contained therein, for it has been proved that it cannot be rent asunder endwise by the elastic force of steam contained, since it would burst open laterally with half only of that force. If it burst open laterally, the reaction from the side opposite to the fracture is the only force of steam which can produce motion, but the reaction is perpendicular to the side, and cannot produce motion in the direction of the axis. The boilers of the steamboat *Medora* were projected endwise over her stern into the Mississippi, February 11, 1847. A boiler in a mill at Greenbush, opposite Albany, was projected endwise across the street into the second story of a storehouse by an explosion, June 4, 1847: and numerous other cases have occured wherein boilers have been projected endwise in some instances to a great distance, which it was impossible for the elastic force of steam to effect, and must have resulted from an almost unlimited explosive power. The origin of this explosive power, and the causes by which its action is induced or varied, are the real questions, and for them there is no solution to be found in the history of the boiler or the analysis of its contents.

(*To be concluded in our next.*)

RUTTER'S PATENT ALARMS FOR THE PROTECTION OF HOUSES, WAREHOUSES, ETC., FROM FIRE, TRESPASS, AND ROBBERY, AND OF RAILWAY TRAINS FROM ACCIDENT.

[Patent dated June 22, 1847. Patentee, J. O. N. Rutter, Esq., Brighton. Specification enrolled December 22, 1847.]

The principal agent employed in the alarms which constitute the subject of this patent is electricity; and to no purpose, probably, could it be applied with more extensive benefit, excepting always its use as a means of instantaneous correspondence between distant places. To give a person instant intelligence of danger of fire in any part of his dwelling-house, or of the intrusion of any trespasser or burglar, and this in the dead of night as well as in the day time—to make it impossible for heat to burst into flame, or for a single door or window to be opened without an alarm being given to the party (usually) most capable of taking such measures of safety as the circumstances may dictate—to make the danger its own herald, the midnight thief his own betrayer—to carry along with you to the railway train, the same protection from fire which you enjoy at home, and a means also of telegraphing danger of every sort to life and limb, to the driver and guard;—such are some of the leading objects contemplated by the present invention. And certainly it would be difficult to imagine a class of objects in which more people are interested, or which more nearly concern the security and comfort of families and individuals. Of the efficacy of the contrivances by which Mr. Rutter carries out these objects, no reasonable doubt can be entertained; they are of the same simple and practical character (yet most ingenious withal) which distinguishes all this gentleman's contributions to applicate science.

We shall extract from Mr. Rutter's specification the description which he gives of each sort of alarm; but may previously observe, that he lays no claim to any particular sort of battery to obtain the required current of electricity, though giving the preference to Smee's; and that here intensity in the current is not of so much consequence as constancy and uniformity.

Fire Alarm.

An alarm apparatus, such as is afterwards described, is placed in some one apartment of the house or building, as, for example, the sleeping room of the master, overseer, or watchman, and a galvanic battery is placed in some other convenient apartment of the same, where it may be secured from interference. A thermometer is also placed in every one of the apartments and passages of the house or building, and a double series of copper wires are so laid throughout the premises, that on a given rise of any one of the thermometers, it shall immediately put the wires in communication with the battery and alarm apparatus, and so bring the latter into action. The wires may be fastened, like bell wires, to the walls of the passages, rooms, or other parts of the house, building, or other premises, but must not be in contact with each other, nor with any other metallic substance calculated to divert the current of electricity. They may be led along the walls, near the ceiling; unless concealment be desirable, in which case they may be conveniently placed behind skirting-boards or underneath the floors. One of the wires must be continuous in its course from one pole of the battery to the self-act-

Fig. 1.

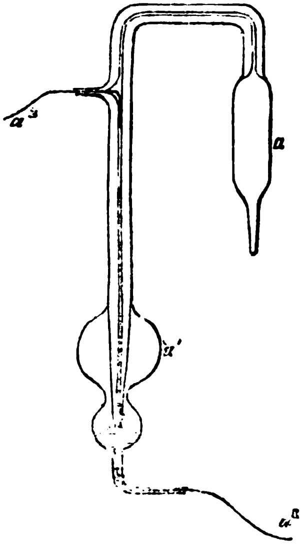


Fig. 2.

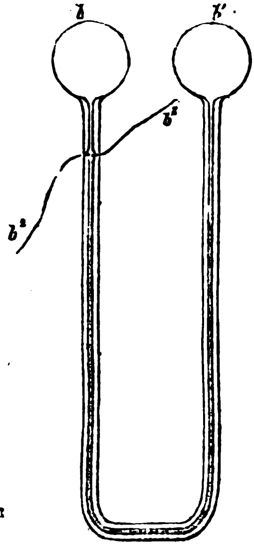


Fig. 3.

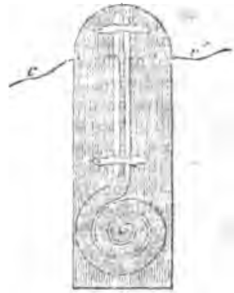
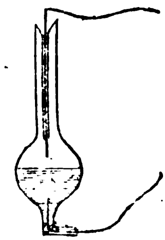


Fig. 5.



Fig, 4.

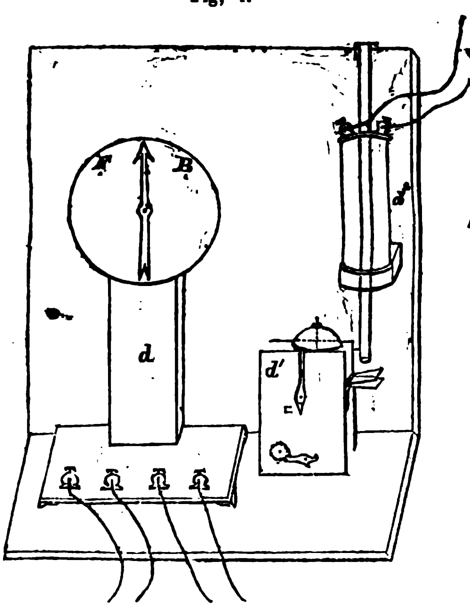


Fig. 6.

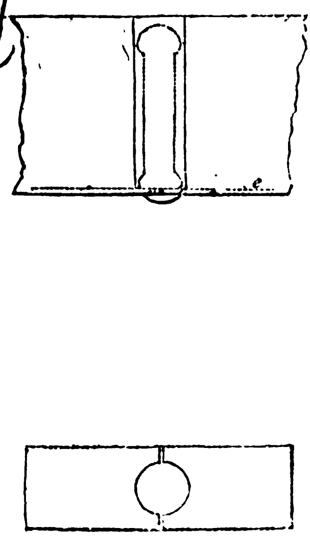
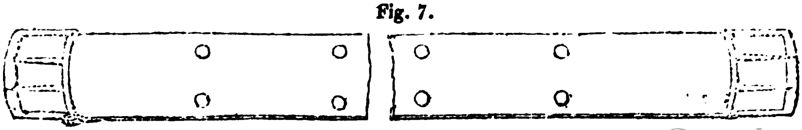


Fig. 7.



ing alarm apparatus, whilst the other wire must be separated or interrupted in its course according to the number of apartments and passages to be protected. At the separated or interrupted parts of the last-mentioned wire, I fix thermometers in the apartments or passages, and the nearer to the ceiling the better; which thermometers are either constant or differential, but one or more of each kind is preferable, These thermometers are so constructed as that metallic contact is formed, by means of platinum wires, with the separated parts of the copper wire last mentioned; but in such manner that until the thermometers are acted upon by a certain amount of heat, so as to cause the expansion of air or other elastic substance within them, a current of galvanic electricity cannot pass from one part of the copper wire to the other; but as soon as a certain amount of heat is applied, the mercury in the thermometers produces a continuous metallic circuit, and a current of galvanic electricity will pass through them. The same arrangements which will serve for fitting up one thermometer, may be adapted to any required number; the conditions to be observed being such only as are well known and understood by persons practically acquainted with electrical agencies; that is to say, each thermometer, in its ordinary condition, is to interrupt the electrical current: but whenever any one of the thermometers is acted upon by the required amount of heat, the electrical current shall instantly be transmitted from the battery to the alarm apparatus before alluded to.

This alarm apparatus consists of three principal parts; namely, a vertical galvanometer, an alarm bell, and a small electro-magnetic coil, with a magnet and a bar or rod of iron connected therewith. The galvanometer is fitted up in the usual manner, with a vertical needle traversing the upper part of the face of a dial, with stops on each side; provision being made for reversing the galvanic current, and thus causing the needle to move to the right or left hand of the observer, according to circumstances. The alarm bell may be a spring alarum, commonly so called, to run for any definite period, or it may be a single-stroke bell—both of which are well-known instruments. The electro-magnetic coil contains within it a tube of brass, in the upper part of which, above the coil, is fixed a small, permanent steel magnet; and in the lower part a rod of soft iron, of such size and weight that the magnet shall just sustain it in a vertical position. Matters being thus arranged, the wires being connected with the respective poles of the battery, the galvanometer and electro-magnetic coil being made parts of the circuit, and the battery being in proper action, the galvanic current is lying in ambush, as it were, ready at any moment to cause an alarm to be given; and such alarm will to a certainty be given whenever the electrical circuit is completed. For example:—If the mercury in one of the thermometers should be raised a given number of degrees above that indicated by it as the ordinary temperature of the air in the room, it will by such rise be brought in contact with the platinum wire in the tube, and by that means complete the circuit; the effect of which will be the instant separation of the electro-magnet from the permanent magnet, which in falling will disengage a stop or detent of the alarm bell, which is thereby set a ringing; whilst the needle or pointer of the galvanometer is deflected to the right or left hand, according to the direction of the current, and thereby points to a letter or word denoting the cause of alarm. By a suitable arrangement of the wires with galvanometers, the exact locality of the danger may be indicated, as well as the cause thereof.

The wire used may be of the ordinary size and kind usually employed by bell-hangers; but I prefer that more commonly employed for electro-magnetic purposes, covered with cotton thread and of various colours. Thus, for the conducting wire of the fire-alarm, I use wire covered with red cotton thread; and for the return wire from the alarm apparatus to the battery, a wire covered with white cotton thread. The use of wires of different colours greatly facilitates the arrangements; and they can be more easily traced in their several junctions with the various parts of the apparatus.

Figs. 1, 2, and 3, of the engravings annexed, represent the different sorts of thermometers which I employ for breaking and renewing the electrical current in all cases where temperature is concerned. Figs. 1 and 2 are differential thermometers; the bulbs, *a a'*, *b b'*, being charged, or filled with air, and the quantity, or elastic force, of the air in the respective bulbs determines the situation of the mercury and the change of temperature necessary to be produced in one of the bulbs to elevate the mercury to the height in the stem, required to cause the transmission of any electric current through it. One of the bulbs of each thermometer, *a* and *b'*, must be enclosed in a case, or covering, of wood or other non-conductor of heat; the differential thermometer being applicable to all situations and all seasons, provided it be required to indicate sudden changes of temperature only.

Fig. 3, is a constant thermometer, which is to be so adjusted as that the electrical current shall pass at any specific degree of temperature. a^2, a^3, b^2, b^3, c, c^1, are conducting wires, to be connected with the copper wires before mentioned, by means of binding screws, by twisting the ends together, or by soldering, or in any other way the most convenient or desirable for effecting perfect metallic contact.

Fig. 4, represents the alarm apparatus; d, being the galvanometer; d^1, the alarm-bell; and d^2, the magnet and electro-magnet with its coil and other necessary appendages.

Trespass and Robbery Alarm.

For effecting the objects contemplated in this part of my invention, an additional wire must be fixed communicating with the battery at one of its extremities, and with the self-acting alarm apparatus at the other, in the same manner as for the fire alarm already described; it being observed that the connection with the galvanometer is so made as that by a reversal of the current of electricity passed through it, the needle shall be deflected in a direction the reverse of that in the case of an alarm being given of danger of fire. For breaking and renewing the electrical circuit by the opening and shutting of doors and windows, at the separated or interrupted parts of the conducting wires, tubes containing mercury, similar to thermometer tubes, but open at the top, must be secretly fixed in or near to the frame of each door and window which is to be protected. In each tube, at the bottom, a platinum wire is fixed in contact with the mercury, and another platinum wire, moving freely in the upper part of the tube, is so connected with and influenced by the movement of the door or window, as the case may be, that so long as it remains shut, the point of the wire shall be above the surface of the mercury in the tube, but the instant it is opened the wire shall descend below the surface of mercury, and by that means (as is hereafter more fully explained) the electrical circuit is completed, and an alarm given in the same manner as before mentioned. I adopt occasionally other methods of completing the electrical circuit. For example: for guarding sash-windows, I fix an additional pulley-wheel in the boxing on one side of the sash-frame, and thereby make the sash-line and pulley-wheels, as at present in use, available for the purpose; the necessary metallic contact being effected by a piece of fine copper, or brass wire being woven into, or interlaced with, or twisted around the sash-line. Or I fix a small disc, or plate of brass, or other metal, divided into two parts, in the rabbit or other convenient part of the upper portion of a door or window-frame; each part of the said disc or plate being in metallic contact with the conducting wires before described. And to break and renew the electric circuit through, or by means of the disc, or plate, a ball or knob of brass or other metal is so fixed and concealed in the door or window-frame, that as long as the door or window remains shut, the ball or knob cannot come in contact with either part of the disc or plate; but when opened it rolls or falls by its own weight into an aperture formed for its reception, and thus causes the electric circuit to be completed, and an alarm to be given.

Fig. 5, of the engravings annexed, represents a mercurial tube with the wires connected therewith, for breaking or renewing the electric current by the opening or shutting of a door or window; and fig. 6, represents a plate or disc of the description just mentioned, for breaking or renewing the electric current.

The letter F, on the dial of the galvanometer (fig. 4) is intended to denote "fire." and B, "burglars."

Railway Alarm.

To accomplish this object, it is necessary that two conducting wires should be laid along the roof or underneath the bottom or other convenient part of each carriage, luggage-van, tender, or other part of the train, which wires may be in metallic contact with the coupling chains, or be independent thereof, as may be deemed most convenient. I prefer that the wires should be fixed independently of the couplings, and insulated in every part, terminating at their extremities in strong hooks of brass or other metal. The connection between the respective carriages is effected by means of flexible wire cords terminating in rings of brass or other metal, to be passed over the hooks before mentioned, so that the wires may be connected quickly and easily at the same time, and by the same person that shackles the carriages. The flexible wires just mentioned must be inclosed in bands of leather or other suitable material, and with the hooks before mentioned, protected from rain, dust, or contact with any part of the carriage or train, by suitable coverings of caoutchouc, gutta percha, or other waterproof material. From the tender the wires must be conducted in an insulated state to the platform or foot-plate, occupied by the engine-driver, and thence to a strap of leather,

(see fig. 7,) gutta percha or other insulating substance affixed on the hand-rail at the left-hand side of such platform or foot-plate. Along the upper side of this strap (so affixed to the hand-rail) must be two rows of studs or buttons, of brass, or other metal; one row being in metallic communication with one conducting wire, and the other row with the other wire. The studs or buttons may be arranged as follows:

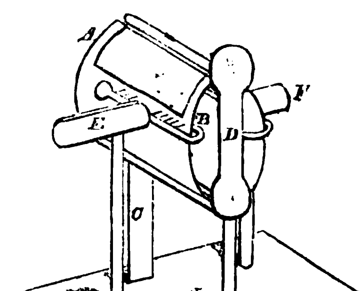
a—0 0 0 0 0 0
a'—0 0 0 0 0 0

and at about double the distances apart here represented. They must project their whole thickness above the surface of the leather or other substance to which they are fastened. In the box, or near to the seat occupied by the guard, must be placed a small galvanic battery (that known as Smee's Constant Battery, or that usually denominated a sand battery, being well adapted for the purpose,) with an electro-magnetic primary and secondary reel or coil, similar in its construction to that commonly used in communicating shocks in the application of medical galvanic electricity. One of the poles of the battery and the ends of the conducting wires being connected with the reel in the usual manner, the other pole of the battery must be fitted up with a short length (according to distance) of flexible wire cord, covered, excepting to within about an inch of its extremity, with leather, or some other flexible waterproof material. These arrangements being completed and the battery in proper action, and the wires throughout the whole train being connected, and the driver and guard being in their respective places, if the driver place his hand upon the rail (which he usually holds on by when the train is in motion) and in contact with any two of the studs or buttons, as shown in the opposite rows, *a*—*a'*, he is in a situation to receive at any moment a signal from the guard, and which may consist in communicating one, two, or more gentle shocks to the hand of the driver; the electrical circuit being completed by means of the flexible wire attached to one pole of the battery, and which is placed for an instant in contact with the corresponding pole of the electro-magnetic coil, and then suddenly withdrawn. The number of times in succession, or the order in which the shocks are communicated, will constitute signs or signals, as may previously be determined upon. In addition to the studs or buttons fixed in the strap before mentioned, flexible wires, properly protected, may be connected with the conducting wires, and terminate in a ball or handle of convenient size, to be held by the engine-driver in his hand, or fastened by a strap or string to his wrist. By this means he will be always in actual contact with the apparatus; so that if the guard exercise suitable vigilance he may signal the driver in a moment with unerring certainty, and without causing any alarm to passengers. By arrangements similar to those just described, the passengers in each carriage may be provided with the means of communicating a sign or signal to the guard or other conductor of railway trains. The intensity of the shock may be modified by the adjustments on the reel. It is perfectly perceptible, without causing any sensation of pain.

By means similar to those which have been described, the guards, when there is more than one to a train, may communicate signs or signals from one to the other.

From these exemplifications it will be readily understood how the same system of conveying alarms may be applied to manufactories, docks, ships, mines, conservatories, &c., with such modifications only as difference of circumstances may render obviously necessary, and as will readily suggest themselves to practical men of ordinary intelligence.

DOUBLE POWER ELECTRIC MACHINE.



Sir,—It is perhaps due to the superior interest which attaches to galvanic electricity that the frictional electrical machine still remains so expensive a piece of apparatus. One method of increasing the power of the cylindrical machine, *cæteris paribus*, is, I think, the following:

Let the cylinder, AB, be of the usual shape at one end, but open at the other. The end with the neck may be mounted in the usual manner, and work in the pillar, C; the cylinder being turned either by a simple handle or multiplying

wheel. The negative conductor, D, is placed at the open end of the cylinder, and to it are attached two pairs of cushions resembling those of *plate* machines, pressing on the *outer* and *inner* surfaces of the glass, and furnished with flaps covering each one quarter of either surface. To receive the electricity of the excited glass there are two conductors, EF, furnished with *double* rows of points, one set drawing off the fluid from the *outer*, the other from the *inner* surface.

The cylinder should be of greater diameter in proportion to the length than those commonly employed, in order that the negative and positive conductors may not be too proximate. The plan of having two cushions, one rubbing against the upper and the other against the under side of the cylinder, has been already applied with success.

It might be thought that the weight of the glass and the friction of the cushions would break the neck of the cylinder, but the *cushions themselves* support it, and replace the other pillar which is employed in machines of the ordinary form.

Perhaps some of the numerous amateurs who read your valuable Magazine will think it worth while to adopt the above principle in the construction of a machine.

I am, Sir, yours, &c.,
M. N. C.

CAMBRIDGE MATHEMATICS.

Dear Mr. Editor,—Will you permit me to ask your correspondent of the "Temple" (writing under the signature " $\pm$ ") one or two questions respecting the purport of his letter?

1. What are the real points at issue between that gentleman and " your reviewer?" I have sought in vain through the review for the phantom that appears to haunt him; and, to my apprehension, he has only strengthened the position I had taken by his attack. Bad generalship this, for a redoubted Templar to commence the tournament with!

2. Has he not admitted all in favour of the Greek geometry which I had claimed for it? Some of his admissions are rather oddly expressed, it is true, and some of his expressions are not very intelligible to my understanding: but the *claims of geometry* are admitted—and that is enough.

3. Does he not admit that there are yet many unexplained difficulties constantly occurring in the use of the Cartesian method of investigation? Did I say more than this in the reviews in question? We do not differ here, then.

4. He admits, again, that the " Greek geometry is the most noble handmaid of clear thinking and rigid reasoning?" I do not, indeed, comprehend *his reasons* for this superiority over other " handmaids" to thought, either as regards the " instruments" or the " results" of the Greek geometry. This, however, matters little: as we are fully agreed respecting the proposition itself, though we may differ in our reasons for its adoption.

5. What am I to understand from the following paragraph?

> "Your reviewer writes as though the puzzling intricacy involved in many geometrical problems were really of advantage in teaching the student *how to think*. Now it appears to me that the thought most required for strengthening the mind, is that *employed in the logical sequence of processes, not on the simultaneous apprehension of complicated constructions.*"

My first difficulty consists in finding, in any one of my writings, a single passage which could even suggest such a strange fancy as he has attributed to me in the first sentence of the quotation above; and I request to be informed *where* I have written either so carelessly or so absurdly as to justify his putting forth such an interpretation of my views.

My second difficulty is, to discover what he understands by the Greek geometry, if it do not in the most extraordinary degree require the exercise of " *tracing the logical sequence of processes.*" Upon this he will, doubtless, enlighten me. I will tell him candidly what was the impression made upon my mind by the entire passage quoted in italics, taken in connection with the reasons which he gives for believing geometry to be the most " noble handmaid of clear thinking and rigid reasoning:"—that he considered the Greek geometry to be merely a system of instrumental construc-

tion. Yet he professes himself "an ardent disciple of the pure geometry school." In short, I am puzzled. To my apprehension, it is in the symbolic methods that the mind is totally and peculiarly *not* "employed in tracing the logical sequence of processes:" for assuredly the "mind" is there relieved from such "ungentlemanlike drudgery!"

6. The following passage has also interested me:

"It is natural that after long confinement to *the poles and polars* and the pure geometry, and on the *bursting forth of the Cartesian system*, the tide of study should pass up *this new channel* and overflow, and leave all others dry."

Now it has been my opinion (it would seem too hastily taken up) that *poles and polars* were, so to say, a subject of yesterday, and not one of speculation amongst the Greek geometers, nor even anterior to the time of Descartes. The *principle* that runs through the whole system I had always thought to be due to La Hire; and the full development of it to have been made within the present century — by Monge, Hachette, Gergonne, Servois, Poncelet, and their *élèves*. Either, then, the Templar's chronology is a little at fault, or my own notions about the history of geometry are very superficial. Which?—If the error be *mine*, your correspondent will do me an especial favour by pointing out any author who had treated on this subject anterior to the period of Descartes, and who has been swamped by the "bursting forth" of the Cartesian "tide."

7. Your correspondent also writes thus:

"The time given to science in Cambridge is far too short to *allow of much being learned:* but SURELY when *but a hurried glimpse can be obtained of the* STRUCTURE *of mathematics*, transversals should yield to integration, and radical axes to conjugate lore."

Why so "surely?" It is begging the whole question;—it is *assuming* the superiority in an educational point of view of "integration" and "conjugate lore"—though I confess that I know of no department of mathematical inquiry* that bears the title of "conjugate lore." Whatever branch of occult science this may be, your correspondent begs the question, till he answers to the "*Why?*"

But is there really "too short a time allowed at Cambridge to allow of much being learned;" and is it inevitable that the undergraduates can only get "a hurried glance at the structure of mathematics?" What, then, do they employ their "three years and an odd term" upon? The classics? They make a poor show in this way when out in the world, at any rate; and not one in a hundred looks into a classical author between the time of "the little go" and his being appointed a college classical examiner. Perhaps I may be told of Paley's "Evidences" and "Ecclesiastical History" as a part of the Cambridge curriculum. Well, *how much of these?* and *what subjects else* occupy those three long years? I cannot comprehend the cry of "the time being too short."

As regards the superficial "glimpse," and the superficial acquirements from that "hurried glimpse," I confess myself unable to account, if this be true, for any man whatever obtaining that amount of mathematics which, to my own knowledge, many men do bring with them from Cambridge with their B.A. degree. I should feel that I was doing Cambridge a great wrong were I not to doubt the accuracy of your correspondent's statement on this head, and ask him for the proofs. Till these are given, I shall rather incline to the opinion of Mr. Leslie Ellis (expressed at the last Centenary banquet at Trinity) that as far as the ordinary degree is concerned, *one year* is amply sufficient to learn the subjects required for obtaining it. I am, however, open to conviction, should sufficient reason be offered for changing my opinion.

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* We owe it to "$\pm$" to insert his correction of this and another passage, addressed to us in a letter since the above was in type:

"Sir,—You will oblige me by correcting two errata in my communication on 'Cambridge Mathematics.' inserted in your Number of last week. For 'can geometry help *no* more than algebra,' &c., read '*any* more than algebra,' &c. For 'conjugate *lore*,' read 'conjugate *loci*.'

"I am, Sir, yours, &c.,

"$\pm$."

"Temple, Wednesday."

8. As to "the Senate-house papers," the question is one that involves both *judgment and experience*. It is too delicate a point, therefore, for any two men to discuss in such a form as this. Your correspondent and myself have given the *results* of our judgment and experience, be they worth little or much; and as we both "wear our visors down," the weight to be attached to the *ipse dixit* of either must be left entirely to the judgment of your readers.

9. Like your correspondent, I have kept his "most serious charge for the last." It

—"is that which upbraids the Cartesian geometry, because it is after all founded on the ancient system, making it therefore a cause of blame that its founders should not have entirely discarded former science. Why, Sir, we might in algebraic geometry adopt what symbols for a given condition of lines and what interpretation of given symbols suited our fancy, provided that no two dicta were opposed to or inconsistent with each other. Thus your reviewer is mistaken when he asserts that the explanation of the sign $-$ had to be sought for in geometry. On the contrary, it was assigned to a certain condition, and might have been given to a totally different one, say to the condition that a right line $-x$ shall be measured in a direction perpendicular to the right line $+x$," &c.

Now *where* have I made any such "charge" against the Cartesian methods as that here quoted? I certainly did condemn some recent attempts, both in France and at Cambridge, to build up a system of trigonometry and algebraic geometry, *upon a basis independent of all reference to geometry:* but this is precisely and strikingly *the reverse* of the charge here preferred against me! Your correspondent does not serve the cause in which he has entered himself a volunteer by such strange perversions as this; and I am very curious to see how he reconciles his own version of my views on this matter with anything that I have ever written. The *onus* rests with him, to prove that he has not falsified my statements—no doubt unintentionally, but still injuriously. If he be serious, he must think me a mere "mooncalf:"—if not serious, I would remind him that the jury, though impannelled, is not bound to give its verdict *instanter*, or be "locked up." The *public* will take time to deliberate and think.

The passage quoted above also contains another misrepresentation:—that I considered the "*explanation* of the sign *minus* had to be sought for in geometry." I never even dreamed such nonsense. The "explanation" of the sign had been fixed *by definition* before any application of algebra to geometrical research had been thought of; and the great difficulty that stood in the way of algebraic development was to determine the *result of combining* the signs + and −, in the case of multiplication and division. Where have I said more than this:—that in early times the truth of the equation $-a \times -b = +ab$, reposed for its evidence *solely on geometrical considerations*? Here, again, the onus of proving me in error falls on your correspondent: but I do intreat him to lay aside this system of quibbling misrepresentation when he next deigns to honour me with his refutation of my contributions to your Magazine.

Finally: my objection did not lie against using the coordinate method of investigation, but against the use of it on occasions to which it was not suited—universally, in fact. It does so happen that my own studies have led me to cultivate both systems, and to have extensively employed both; and on the authority of my own personal experience I am led to form the conclusion which I have already expressed—that the *actual constructions* which result from the Cartesian process are almost invariably more complicated than those obtained from purely geometrical considerations; whilst in no one case whatever have I found them more simple and direct. The same remark applies with equal force to the *demonstration of theorems*—that the enunciated truth is, in general, less clearly and definitely expressed by the Cartesian method than by the geometrical. Have I said more than this in the papers to which "$\pm$" objects? Will any person who has tried both methods so far as to obtain moderate, but equal skill in them both, deny what I have

said? The fact appears to be that your correspondent has assumed that by the ancient geometry, I mean all inquiries whatever that relate to figures and space; and that he then proceeds to consider me an advocate for the expulsion of all symbolical modes of research from our mathematical and physical inquiries. I have, however, only advocated the treatment of those classes of subjects which the ancients considered geometrical by the ancient geometrical methods; leaving the more extended researches (those into curves and surfaces of higher order than the second, and all physical researches) for the methods which are better adapted to the purpose. The ancient geometry ought to be read in the ancient manner *before* the Cartesian is entered upon,—in order to give something of clearness to the student's conceptions of the modern method. Is the "ardent disciple of the pure geometry school" prepared to dispute this rule? and if not, with what is it he is cavilling? Not, surely, with anything that has been *written by me*.

At some future time I may return to this subject; and in that case, I shall point out the *causes why* the Cartesian geometry must be always less efficient than the ancient method for the investigations of problems and theorems relating to the line and circle. Meanwhile, will "$\pm$" be so good as to point out the interesting results of which he intimates the existence, which "could never have been filtered through the line and circle?" They will be new to me.

Adopting the obliquely-depreciating title conferred upon me by "$\pm$," I subscribe myself, Dear Mr. Editor, yours sincerely,

"YOUR REVIEWER."

THE ELECTRIC TELEGRAPH.

On the 1st inst. the Electric Telegraph Company opened the Metropolitan Station in Lothbury, for the transmission of communications to upwards of sixty of the principal cities and towns of Great Britain. The Company's lines now extend over more than 2,300 miles. The only large towns *not* in communication with the Metropolitan Station, are—Bath, Exeter, Plymouth, Brighton, Chatham, Oxford, and Preston. For the present, the Company are contenting themselves with a rate of transmission not exceeding six words a minute; and they do not hold themselves responsible for any given rate of speed. Mr. Bain's plan, by which 1000 characters per minute may be telegraphed, has been purchased, but not yet carried into practice, by the Company. The charges are high—being for the transmission of a message of about 100 words from London to Liverpool £5; and so in proportion for other places. But no doubt these will be diminished when the Company's arrangements get more matured, and they are better able to transact any amount of business which may be offered to them. The Directors appear to be acting on the policy of checking rather than encouraging the use of the telegraph by the public, until their establishments are everywhere in perfect working order.

MR. WALLER'S CAFFETIERE.

"Denique sit quod vis *simplex* duntaxat et *unum*."
HOR.: de Arte Poeticâ.

Sir,—The favourable opinion which you were pleased to pronounce on my patent coffee-pot, founded as it was on experience, in the 1266th No. of your esteemed periodical, seems to have thrown your two correspondents, Mr. Macgregor and Mr. Clive, into some degree of alarm. The horror entertained by these two gentlemen for *valves* would perhaps diminish, were they to take the trouble of examining the beautiful archetypes with which nature (*dives opis naturæ suæ*) has supplied us. Why, Sir, a valve is one of the most perfect pieces of mechanism with which the ingenuity of man has benefited his kind. The valve in my *Cafetière* will not *trouble* "general users" more than do those in their own hearts, for they will have nothing more to do with it than they have with these: neither do I conceive that giving *two half turns* to a tap, and once removing or opening, and once closing or inserting a stopper within the space of three minutes, and by so doing obtaining a quart or two of brilliant coffee, will impose more labour than standing with a kettle and pouring in water by *instalments*, "mashing" and "smacking" the fine particles of the fragrant berry, all the time presenting that to the nose which my apparatus, in its exclusiveness, reserves for the palate. I may remark, in conclusion, that there is one modification of my apparatus for travellers, in which the spout is inclosed inside the upper division, and presents only externally a "hole" for pouring out; the

contrivance for opening the way between the upper and lower chamber is also inside, presenting externally a small knob at the lid, and the handle screwing in and out of a "hole" at the side, can be packed in the interior of the vessel.

I am, Sir,
Your constant reader,
F. H. WALLER.

Jan. 1, 1848.

THE SPRAY PUMP.

Sir,—I should be very glad if Mr. Adcock would answer me the following questions, which if truly answered will save much discussion:

Has any coal, or other pit, been drained by his method regularly, say to the depth of not less than 60 fathoms? If so, by what power of engine? what quantity of water in a given time in gallons? and at what cost or consumption of coals?

The true particulars, stating diameter of steam cylinder, length of stroke, number of strokes per minute, and average pressure of steam in pounds, with quantity of coals, will give unlearned persons like myself a better opportunity of judging of its merits than such angry discussions, vague descriptions and confused statements as have lately appeared in your columns.

I am, Sir, yours, &c.,
ROBERT BROUGH, (Collier.)

Begelly Tenby, December 22, 1846.

THE SPRAY PUMP.

Sir,—There seems to be something connected with the action of Mr. Adcock's spray pump that deserves investigation. I confess I do not understand the why and the wherefore of the operation, except with reference to a new or hitherto unobserved principle of nature being involved in it, such as water losing its gravity by conversion into spray. I have been told, however, that Mr. Adcock denies any new principle.

It is asserted, and not denied, that at the lowest scale, a column (or something in the shape of a column) of water of 20 feet in height is supported by a column of air pressure of at most 4 lbs. on the inch, whilst 20 feet of water cannot be much less than 10 lbs. on the inch.

Does not "Cassel Morlais" at p. 552, (No. 1269) in his calculations of engine power, leave out the pressure of the atmosphere, as induced by a vacuum 15 lbs. on the inch, when perfect.

I am, Sir, yours, &c.,
J. H. CLIVE.

Clanway Colliery, January 11, 1846.

LIGHTS FOR STEAMERS.

The attention of the Board of Admiralty having been repeatedly called to the necessity of establishing a uniform system of lights for steamers, directions were given (after a long and careful series of trials of various lights) to fit the several mail steamers on the west coast of England, namely those of Liverpool, Holyhead, and Pembroke, with lights as follows:

When under Weigh—A bright white light on the foremast head—A green light on the starboard bow—A red light on the port bow, to be fitted with inboard *screens*.

When at Anchor—A common bright light.

On the above plan being notified, it was adopted by several steam-boat proprietors; and the vessels of the steam companies named below are fitting, or are already fitted with these lights:—1. The British and North American Royal Mail Company. 2. The British General Steam Packet Company. 3. The Glasgow and Liverpool Steam Packet Company. 4. The Chester and Holyhead Company. 5. The Peninsular and Oriental Steam Packet Company. 6. The West India Royal Mail Steam Packet Company.

The experiments thus made proving satisfactory, the Board of Admiralty have given directions not only that all steamers in her Majesty's navy, but all steam-vessels belonging to Great Britain, shall be fitted with the above coloured lights and screens. Sufficient time will, however, be given for the owners and masters of steam-vessels to become acquainted with the plans, before the notice is published in the *London Gazette*, requiring them to show these lights; and this will probably be in the month of March next.

NEWTON'S IMPROVEMENTS IN WHEELS.

[Patent dated June 29, 1847. Patentee, Mr. E. Newton. Invention communicated from abroad. Specification enrolled December 29, 1847.]

The present invention is stated to consist in a peculiar method of casting iron wheels for locomotive engines and railway carriages, and to have for its object the uniform cooling of the various parts of the casting, and thereby to avoid fracture from irregular chilling.

The patentee observes, that soon after the advantages of iron wheels with chilled peripheries and flanches were established, the difficulty of casting them in one piece was ascertained. The rim was found to cool sooner than those parts which connect it to the "hub" (commonly called nave,) and then to shrink in cooling, and either

break, or become so weakened as to break, on being subjected to a strain or jar. Various methods of overcoming this difficulty have been suggested,—such as the employment of a "slit hub" formed of segments, bound together by iron hoops, and bending the arms or spokes, to allow of their shrinking.

The form of the connecting parts of the wheel which the patentee prefers, is that of a simple disc; and his mode of chilling the rim, flanch, and connecting parts, consists in employing a mould of metal, instead of sand, as heretofore, so that the metallic surfaces of the mould shall come in contact with the surfaces of the casting.

In practice it has been found necessary to chill only one surface of the disc; and in that case, the top portion of the metal is replaced by one in sand, made in the usual manner.

INQUIRIES AND ANSWERS TO INQUIRIES.

Horn.—"Can horn be so softened as to be moulded into any required shape, or pressed into moulds? And can it be made white, or is white horn to be purchased?"—*Querist.* Horn may be softened by a degree of heat not exceeding that of melted lead, and may be afterwards moulded into any required shape. The horn handles of knives, razors, &c., are now commonly made by moulding. The softened horn is first pressed into a mould or die, which is then enclosed in a nut-cracker sort of clamp, and the die, clamp, and horn immersed in boiling water for a few minutes, after which the clamp is screwed as tight as possible, by means of a screw attached to the end opposite the joint. In about twenty minutes the horn is taken out and finished. It is commonly dyed of various colours, and may also, we presume, be blanched, though we do not recollect to have seen any articles of white horn. Ivory is usually whitened by boiling it in pearl-ashes and water; and perhaps horn may be so also.

Lord Rosse's Telescope.—The diameter of the speculum was but a fraction beyond six feet, and the total weight about three tons.

Sir John Robison's Workshop Blowpipe is described in a paper by the inventor himself, in our journal for April 2, 1842.

Globes are covered with very thin paper, on which the earth or firmament has been previously delineated; but the paper must be cut into numerous gores or pieces, to enable it to assume the spherical form without any puckering or unevenness. The number of pieces is usually 26, two of which, called pole-papers, are circles embracing 30 degrees around each pole; and 24, gores of a fish form, divided at the equator.

Buhl Work.—"Whence is this name derived? and what is its real meaning?"—*P. B.* *Buhl* is a corruption of *Boule*, the name of an Italian who first introduced this description of cabinet-work, in the time of Louis XIV. It is used to designate any sort of work in which any two materials of different colours are inlaid one into the other, as tortoise-shell and brass, and cut into the required forms by the saw alone.

Boiler Incrustations.—"Sir,—Permit me to beg some of your correspondents would assist me by informing me, 1st,—Whether Ritterbandt's (or any other) process or patent, will answer the purpose of preventing or destroying boiler incrustation, with a water composed of the following ingredients in the imperial pint; viz.;

Carbonate of lime	1.027
Chloride of Calcium	2.640
Chloride of magnesia	1760
Chloride of sodium	15.370
Sulphate of soda	1.520
Sulphate of lime	.984
Grains and decimals	22.310

"2nd.—Whether such a water might not be expected to be very difficult to work with, and be very injurious to the boiler, if the above or some other remedy is not applied to it, as well as require much fuel and heat?"—*A very Old Subscriber.*

NOTES AND NOTICES.

Electric Railway.—I wonder whether Dr. Colton or the Americans ever read the *Mechanics' Magazine.* I see in your Notes and Notices, Dec. 4 last, an announcement of the practical carrying out (on a model scale) of the electric railway which I suggested a year ago, and which occupies a place in your pages, I am, Sir, &c., JOHN MACGREGOR.

Girder Bridges on Railways.—The Railway Commissioners have, in reply to inquiries as to whether, consequent on the late accident at the Dee-bridge on the Chester and Holyhead line, they intend to make any report on the conditions to be observed in the application of iron to railway structures, replied, that "the Commissioners for inquiring into the conditions to be observed in the application of iron to railway structures, are engaged in preparing experiments to enable them to arrive at satisfactory conclusions on the subject of their inquiry before making their report."

WEEKLY LIST OF NEW ENGLISH PATENTS.

Thomas Hancock, of Stoke Newington, Middlesex, and Reuben Phillips, of Islington, Middlesex, chemist, for improvements in the treating or manufacture of gutta percha, or any of the varieties of caoutchouc. December 30; six months.

Felix Edwards Pratt, of Fenton Potteries, Stafford, earthenware manufacturer, for improvements in manufacturing articles composed of earthenware or china. December 31; six months.

Mary Jenkins, of Atton, Warwick, widow, for improvements in the manufacture of pins, hooks, eyes, and other fastenings. December 31; six months.

Edward Humphrys, of Holland-street, Surrey, engineer, for certain improvements in steam engines, and in engines or apparatus for raising, exhausting, and forcing liquids. January 4; six months.

William Froude, of Darlington, Devon, civil engineer, for improvements in the valves used in closing the tubes of atmospheric railways. January 5; six months.

Read Holliday, of Huddersfield, manufacturing chemist, for improvements in lamps. January 5; six months.

Charles De Bergue, of Arthur-street West, city, engineer, for improvements in carriages used on railways. January 5; six months.

Alexander Robertson Arrott, manager of the Union-place Glass Works, St. Helens, Lancaster, for improvements in manufacturing common salt. January 5; six months.

Charles Lambert, of Two-Mile Hill, St. George's, near Bristol, pen-maker, for certain improvements in machinery for making nails. January 5; six months.

Josiah George Jennings, of Great Charlotte-street, Blackfriars-road, City, for improvements in cocks or taps for drawing off liquids and gasses. January 5; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 30	1305	James Mellin	Levengrove, near Rochdale	Counterbalance candle-holder.
31	1306	Richard Stiven	Arbroath, warehouseman	Improved shuttle for power-loom weaving.
"	1307	John Bedington	Birmingham	Improved measuring-tape, with circular slide-rule.
1848. Jan. 1	1308	Rich. Inwood Cameron	12, Dorrington-street, Clerkenwell, brace-manufacturer	Braces.
4	1309	Francis Baildon Oerton	Walsall	Revolving safety-stirrup.
"	1310	Henry Ed. Thompson	Long Acre	Stands for military tables, washstands, and other articles of furniture requiring similar stands.
"	1311	William Sims	Lower Easton, near Bristol	Improved chimney-pot.
5	1312	Joseph Bunnett	London	Improved effluvia-trap for sewers, &c.

Advertisements.

Errata.—P. 21, line 15 from the top, for "damper alarm," read "danger alarm." P. 21, line 11 from the bottom, for "belt," read "bell."

NOTICES TO CORRESPONDENTS.

Communications received from — *Mr. Leach—Mr. R. H. Thomas—Mr. Giles—Mr. W. Dawson—Ambrosio—An Operative Shipwright—Mr. Sterland.*

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

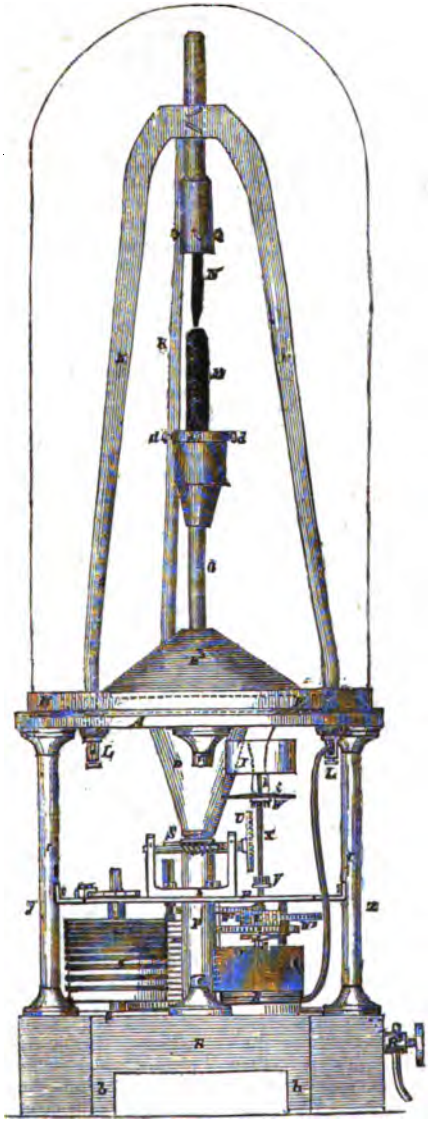
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1275.] SATURDAY, JANUARY 15, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166 Fleet-street.

STAITE'S IMPROVED APPARATUS FOR LIGHTING BY ELECTRICITY.

Fig. 1



MR. STAITE'S IMPROVED APPARATUS FOR LIGHTING BY ELECTRICITY.

[Patent dated January 3, 1847. Specification enrolled January 3, 1848.]

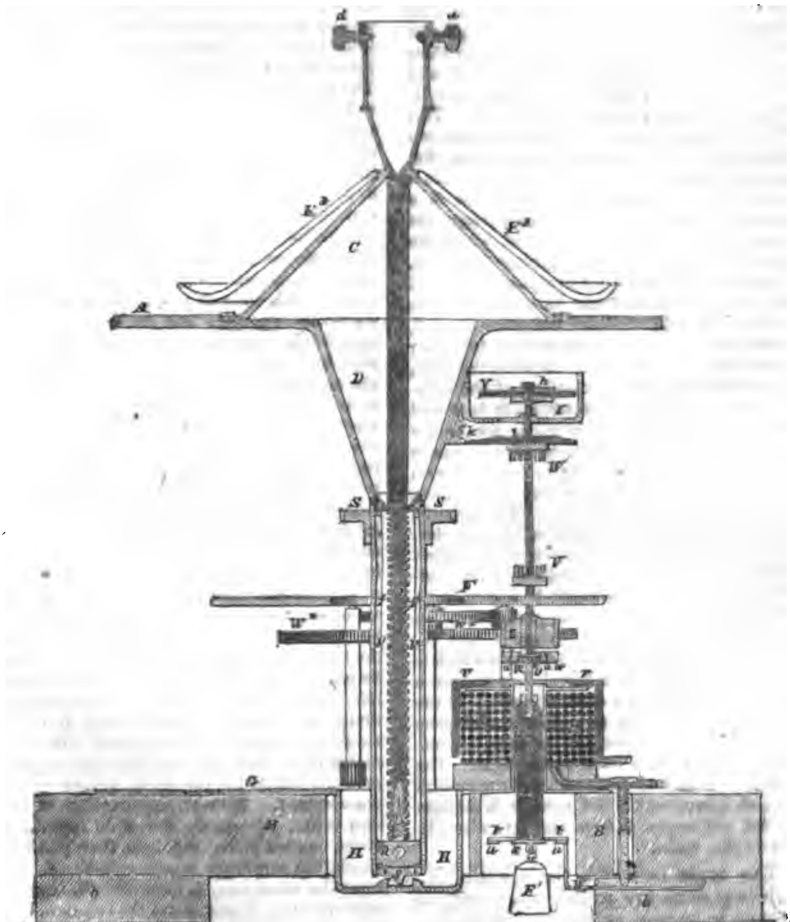
It will be in the recollection of our readers that Mr. Staite was joint patentee with Mr. Greener, of a method of lighting by electricity,—the specification of which we gave at length in our 45th Vol., p. 160. In practice the method was not found to come up to the expectations which were formed of it. Mr. Staite has, however, persevered single-handed with the subject; and now comes forward with an apparatus, which, it is confidently stated, will prove to be all that is desired. It was with this apparatus — though in a very imperfect form —that the very promising experiments were made, at which we were present in June last, and of which we gave an account in our Journal for the 26th of June.

Fig. 1, is an external elevation of the apparatus; fig. 2, a sectional elevation of it on the line, W x (fig. 3); and fig. 3, a horizontal plan on the line, y z (fig. 1). Mr. Staite's description is as follows:

M, and N, are two cylinders of carbon prepared as is afterwards described, which are used as the electrodes, that is to say, the current of electricity is passed from one to the other as they stand end to end, their ends being separated by an interval of from less than one-twentieth to about half an inch, according to the power of the electric current used. The upper electrode, N, is passed vertically through a hole in the summit of the metallic support, or tripod, K, and fixed by binding screws. The lower ends of the legs of the tripod are passed through holes in the circular main-plate, A, of the apparatus, and secured in their positions by collars and nuts, but are carefully prevented from coming into metallic contact with the plate, A, by means of washers, *a*, *a*, of some dry, hard non-conducting wood. The legs terminate at bottom in set screws, L L, which connect them with a conducting wire, which passes round through the extremities of all the legs, and is connected with one end of the coil of the regulator, R. The other end of this coil is led to a clamp, B^2, with a set screw fixed at one side of the square wooden basement, B, on which the whole of the apparatus is built, and which is mounted on four short supports, *b*, *b*, *b*, *b*, at its corners, to allow room for some parts of the apparatus which project below the basement. The main-plate, A, is firmly attached to the basement, B, by four pillars, *c*, *c*, *c*, *c*; C, and D, are cones which spring from opposite sides of the apparatus, their common axis passing at right angles through the centre of the main-plate, A, which is bored out for the purpose. The apices of these cones are perforated, to admit the perpendicular central shaft, O, which has a socket for receiving and holding the lower electrode, M, at its upper end; and this socket is furnished with set screws for securing the electrode in an upright position in its centre, even though that electrode should happen to be of smaller size than the socket. At the bottom the socket is made of a conical form, in order to keep the lower end of the electrode steady and concentric, so that it may be properly adjusted by the set-screws, *d*, *d*. This shaft, O, has a smooth straight part, below its socket, for a length equal to the distance between the apices of the fixed cones, C, and D, which is equal to the amount of rise which the shaft admits of, to compensate for the wear or shortening of one of the electrodes, while the light is in action; this smooth part of the shaft moving freely through the hole in the apex of the upper cone. Below this smooth part the shaft is continued for an equal length, screwed; the threads of the screw giving about one-twelfth of an inch of rise for every turn. This screwed part works through a nut, *e*, which is set tight in the apex of the under cone, D, and passes down the centre of a hollow cylinder or tube, P, which is slotted internally (as shown at *f*, *f*, in figs 2 and 3.) A little cross piece of metal, Q, is set tight on the bottom of the shaft, O, by being screwed fast into its end, and this cross-piece, Q, (which is afterwards more particularly described,) fits across the tube, P, taking into the slots or grooves on each side, so that it can slide up or down in them. When, therefore, the tube, P, is made to revolve, it carries the shaft, O, round with it, by means of the sliding cross-piece, Q, and makes it to rise or sink by its screw working in the fixed nut, *e*, so that the shaft, O, carrying the electrode, M, in its socket, has a rotary motion combined with its vertical motion for the purpose of equalizing the wear of the electrodes on all sides. The tube, P, turns on a pivot, *g*, which works in the bottom of a circular box of metal, H, which is screwed into a hole of sufficient size in the bottom of the brass-plate, G, which is fixed to the upper surface of the wooden basement, B. The touching surfaces at the pivot, *g*, are coated with silver; as that metal presents a surface pecu-

liarly fitted for receiving the current of electricity. The upper end of the tube, P, receives the outer part of the fixed nut, *e*, on which the tube turns, and is steadied as on an axis. On the upper part of the tube, P, a worm-wheel, S, carrying forty teeth, is attached, which is made to revolve by a horizontal double-threaded tangent-screw, T, the pitch radius of which is one-tenth of an inch. To one end of the screw is attached a crown-wheel, U, carrying forty teeth, which is actuated by pinions, V and W, on an upright spindle, X. The pinions are at a somewhat greater distance apart than the diameter of the crown-wheel, U, and gear into it from opposite sides, so that when the spindle, X, is raised a little, the lower pinion, V, (having eight teeth,) is geared into the lower side of the crown wheel; but when the spindle is sunk, the lower pinion is thrown out of gear, and the upper pinion, W, gears into the up-

Fig. 2.



per side of the crown wheel; and the spindle continuing to revolve in the same direction as before, imparts a reversed rotation to the crown wheel. When the spindle is kept at a medium degree of elevation, neither of the pinions is in gear with the crown wheel, so that it remains quiescent. This spindle, X, is kept in its position by working through a hole in the middle plate, F, of the apparatus, which

plate is attached firmly to three of the pillars, *c*. The upper end of the spindle works through a hole in the centre of the bottom of a circular brass box, I, which is fixed to the side of the under cone, D, or to the under side of the main plate, A. The box, I, contains a centrifugal regulator, Y, which consists of a bit of watch-spring bent into the form of the letter S, carrying two little weights, *hh*, at its ends, and fixed horizontally across the top of the spindle by the middle part of the spring, which fits into a cleft in the top of the spindle, and is secured by a small nut. When the spindle is made to revolve too fast, the weights at the end of the spring fly outwards by their centrifugal force, and begin to touch and rub against the sides of the circular box, I, which friction checks the motion. This description of governor preserves the motion more uniformly than the ordinary sort of fly, which acts by the resistance of the air. Just below this centrifugal governor there is a cross-piece, *i*, inserted through a transverse hole in the spindle, X, so that when the spindle is at its medium degree of elevation, that is to say, when its two pinions, V and W, are neither of them in gear with the crown wheel, the ends of the cross-piece, *i*, meet a stop, *k*, which may project from any fixed part of the apparatus, such as the cone, D, and so stop the revolutions of the spindle; while, as soon as the spindle is raised or lowered, the cross-piece, *i*, no longer meets the stop, *k*, but passes over or under it, and allows the spindle to commence its revolutions just before one of the pinions gears into the crown wheel. The spindle, X, is actuated and kept with a constant tendency to revolve in one direction by a toothed wheel, Z, keyed on to it just below the middle plate, F, and this wheel is driven by a train of wheelwork, W², supported between the middle and bottom plates, F and G, similar to ordinary clockwork, and which is driven by a spring in a barrel, *l*, acting on a fusee, *m*, driven by a cord or chain; or the wheelwork may have any other contrivance as its prime mover, as, for instance, a common barrel with a cord and weight. The wheel, Z, is of such thickness that the motion up and down, which the spindle X admits of, will not ungear it from the next wheel in the driving train.

The mode in which the spindle, X, and its pinions are raised or lowered, so as to drive, or stop, or reverse, the motion of the crown wheel, U, and thereby of the electrode, M, according to the exigencies of the light (as, for instance, when the electrode becomes worn, or any alteration takes place in the power of the battery,) is exceedingly ingenious, and is as follows:

The bottom of the spindle terminates just below the driving wheel, Z, and rests on a plate of ivory, *n*, which is supported on a short upright stem of brass, *o*, which has its lower end screwed into a hole in the top of a solid cylinder of soft iron, *p*. This iron can move freely up and down in the central hole of a reel, *q*, round which a quantity of insulated copper wire is wound: one end of this wire is led to the binding screw, B, as before mentioned, which connects it with the positive wire of the galvanic generators, and the other end to the wire which passes through the binding screws, L. The reel, *q*, of the regulator is fixed firmly to the wooden basement, B, and a cap, *r*, of soft iron, fits over it; but the iron of the cap does not extend quite to the centre of the hole in it (through which the brass stem, *o*, passes), the central part of the top of the cap being of brass soldered to the iron, of one-half of the diameter of the iron cap itself. The action of the electricity in the coil of the regulator, R, causes the iron centre, *p*, to rise or fall, according to the quantity of electricity passing, and in so doing, the spindle, X, which rests on it, to rise or fall with it. There is a little eye attached to the bottom of the iron centre, to which is suspended a counterpoise, F¹ (an assortment of such counterpoises being kept for use,) of such weight as to allow the iron centre to be just in equilibrium, or just ready to rise, when the distance between the electrodes is such as to allow the electric current to flow freely enough to produce a steady and certain light. There is also a little ledge, *s*, around the lower end of the iron centre, on which rests a disc, *t*, of brass, of about the size indicated in the drawing, fig. 2; which (when the iron centre falls below the neutral point) becomes supported around its outer edge by a circle of brass, *u*, and is left behind on it, when the iron centre continues to descend, thus relieving it of its weight; while on the other hand, if the iron centre is disposed to rise above the neutral point, it has to lift the whole weight of the brass disc, *t*. This arrangement gives the iron centre a tendency to remain stationary at the neutral point, which is that point at which the elevation of the spindle, X, enables the cross arm, *i*, to come into contact with the stop, *k*, and arrest the rotation, and so prevent unnecessary working of the machinery, until the electric current has varied so much as to render desirable an adjustment of the distance between the electrodes; which the iron centre effects, as before described, by rising or falling.

The neutral position at which the iron centre, *p*, should rest, is when the top of the iron centre is as far below the top of the regulator reel as is represented in figure 2.

The brass ring, *u*, which supports the equilibrium weight, that is the brass disc, *t*, is secured at the proper height by being attached to a sufficiently stiff strip of brass,

Fig. 3.

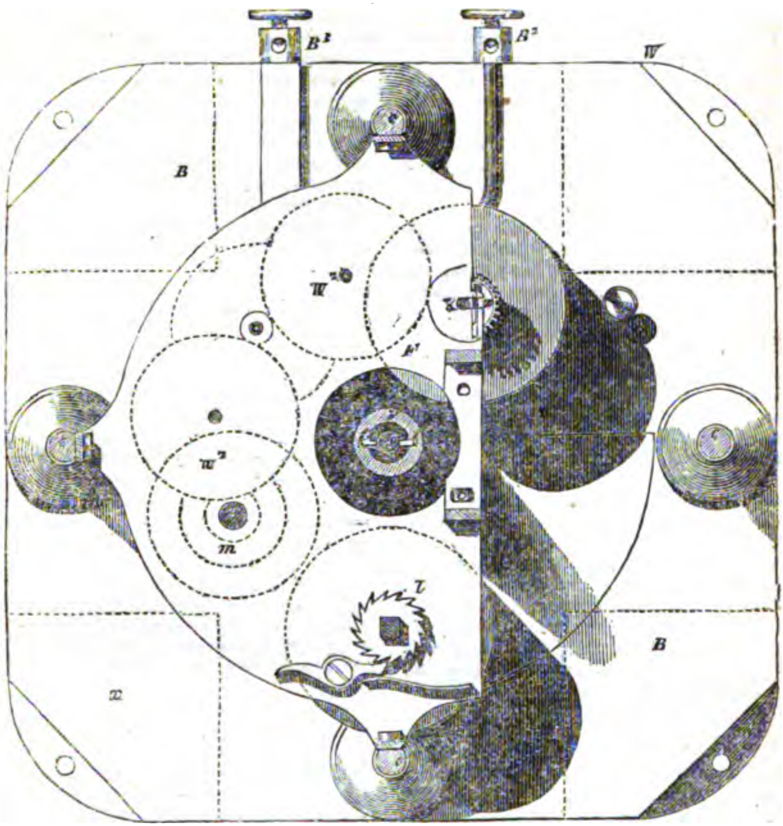
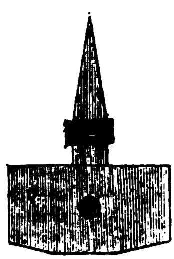


Fig. 4.



w, of a certain length, and which is fixed by its other end to the other side of the wooden basement, B. The brass ring, *u*, can be adjusted to the requisite height exactly,

after the apparatus is made, by a milled-headed screw passing through the wooden basement, and screwing down on the supporting brass strip (not far from x), so as to depress it to the right position.

The sliding cross-piece, Q, before adverted to, is constructed in the manner separately represented in fig. 4. A spring, Q, (of thin hard brass, for instance,) is attached to one side of the cross part by a small screw, so that when the cross piece is placed in the slots of the tube, P, the spring always remains in close though not forcible contact, against the sides of the slots, so as to ensure a good conduction to the electric current which has to traverse the shaft, and enter from the cross piece into the slotted tube.

The tangent-screw, T, is made not quite horizontal, but inclined at an angle of one in twenty, because the lower pinion, V, is smaller than the upper one; and therefore it is necessary that the lower edge of the crown-wheel, U, should be tilted nearer to the axis of the spindle, X. The lower pinion is made smaller, in order that it may the better wind down the main shaft, O, after it has screwed itself up, until the ends of the electrodes come into firm contact, lest it should stick in that position.

The screw, No. 1, which fastens the stand, 3, of the tangent-screw to the middle plate, F, passes through a hole, 4, enlarged sideways in the stand; so that by only loosening the screw, 1, the stand may turn on the other screw, 2, as a centre, so as to allow of the tangent-screw, T, being adjusted to the right distance from the centre of the wheel, S, in order that it may work properly into its teeth, or, when required, to throw the tangent-screw out of gear with it altogether.

The thread of the screw of the main shaft, O, should be of a square form, so that it shall work with as little friction as may be, when supporting the weight of the shaft and electrode.

A cone of white glass or porcelain, E^3, is made to slip over the upper cone, C, of the main plate, and is turned up at the edges (as shown in figs. 1 and 2), to reflect the light better, and to catch any dust and ash which may be thrown off from the electrodes.

A glass shade, which may be ground partially or not, as desired, fits over the electrodes, M and N, and the stand, K, and is screwed down to the main-plate, A, by the brass circle, E, into which its lower edge is cemented, whereby the electrodes are enclosed entirely from the outer air. As soon as they have exhausted the oxygen which is within the glass shade, they are no longer so rapidly consumed. When the electrodes, however, are composed of some inferior sorts of carbonaceous preparations they give light more steadily if a very small quantity of atmospheric air is continually allowed to enter; that is to say, just sufficient to burn away the button of carbon which sometimes forms on the end of that electrode which is not undergoing decomposition by the electric current. When there are no holes in the glass shade to admit of a small quantity of atmospheric air, two light valves may be inserted in the main plate, A, one opening inwards and the other outwards, which would provide for the varying pressure of the air when the temperature is altered by the presence or absence of the light within.

The coil of insulated wire of the regulator, R, should be composed of wire of such thickness as to conduct the electric current quite freely. For an apparatus of the size represented in the engravings it may be about three-sixteenths of an inch in diameter; but if electrodes of a larger size are employed, the wire should be proportionally increased in thickness, and the regulator, R, made as large as the dimensions of the apparatus will admit of, in order that the reel should take a sufficient number of turns of the thick wire; for with wires too thin, considerable heat is evolved from them when transmitting the current. Two circular brass weights, *a a*, fit one over the other around the ivory top, *n n*, which carries the pivot of the spindle, X; their use is to enable an easier and more precise adjustment of the weight on the iron centre than can be effected by altering the large weight, F^1, which is hung at the bottom of the iron centre.

When it is intended to use small currents of electricity, the spindle, X, and all its appurtenances, should be made very light, and the iron centre may for the same object be made hollow with advantage; its sides, however, should not be less than one-twelfth of an inch in thickness.

The electric current may be obtained from a galvanic apparatus of any of the known sorts, or from any other convenient source; and it may be used of various intensities and quantities. A good degree of intensity to use, is such as would be afforded by one hundred cells in a series of the usual sort employed in galvanic apparatuses; and the quantity of the current may vary from that evolved by the consumption of less than one and a half grains of zinc per minute in each cell, to that evolved by the consumption of more than fifteen grains of zinc per minute.

The wire from the positive, that is, the

zinc pole of the galvanic apparatus, is clamped with the binding screw at B^2, which serves as the conductor through the regulator coil, and then up to the upper electrode, N. The wire from the other, or negative pole of the galvanic apparatus, is to be clamped with the other binding screw at B^3, which is connected by a slip of metal (copper) to the bottom plate, G, of the apparatus, so that the current passing from the lower end of the upper electrode, N, to the top and of the lower electrode, M, then traverses the central shaft, O, passes through the cross piece, Q, at its lower end, into the slotted tube, P, and thence through its pivot at bottom into the metallic box or cavity, H, which being in metallic connection with the bottom plate, G, leads the current to that plate and thence by the slip of copper to the other clamp, from which it passes in return circuit through the negative wire of the galvanic apparatus. The current, when first applied with the electrodes in contact, flows freely, and that causes the regulator (being properly weighted) to raise the spindle, X, and thus put the apparatus into gear for screwing the centre shaft, O, downwards, and gradually separating the electrodes, whereupon the light begins to appear between them.

Mr. Staite specifies, also, as included under his present patent, the following method of preparing the carbon for his electrodes:

About equal quantities are taken of coal of a medium quality, and of the prepared coke, known as "Church's Patent Coke," and both reduced to a state of fine powder and intimately mixed together. The mixture is then placed in close wrought iron moulds, which may be made either to give the mixture the form of a block, to be afterwards cut into pieces of the required shape, or to give at once to the mixture the form of the intended electrode. In all cases I prefer making the moulded mass of not more than 3 or 4 inches in its least diameter, for when much larger it is liable to have fissures, and not to be of such uniform density. The mixture being placed in these moulds, is subjected to heat and heavy pressure until it becomes consolidated into a very dense and firm mass. And when the mass is in a heated state it is plunged into sugar, melted by heat (without the aid of any liquid,) and kept therein for a short period. It is then taken out and allowed to become cold, when it is placed amongst pieces of charcoal in a close vessel, which is gradually heated until it attains a full red heat, after which the temperature is increased to an intense white heat; at which it should be kept for many hours, or even two or three days, according to the hardness and compactness desired. Or the mass may be a second time immersed in the melted sugar while hot, and the remainder of the process be again repeated as before.

By coating the mass in this way with melted sugar, any pores that may be in it (on its external surface at least), are filled up with carbonaceous matter, and any subsequent drying rendered unnecessary.

However, Mr. Staite limits his claim as to this method to the application of *melted sugar*. A solution of sugar *and water* has, we believe, been before used for the same purpose.

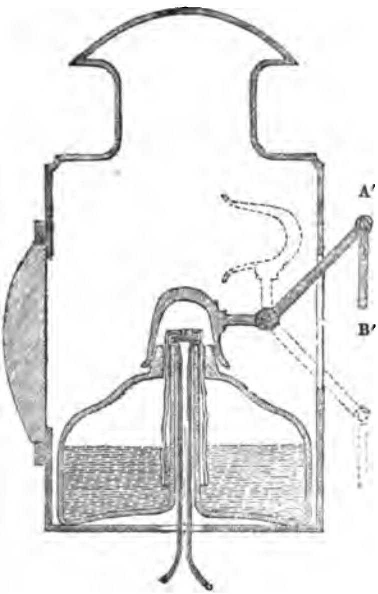
The following are stated to be the best dimensions for the electrodes:

The lower electrode should be as long as can be conveniently manufactured (8 inches, for instance,) when used for ordinary purposes, and it should be of a cylindrical form. The smaller the diameter is the better the light; but the larger the electrode is (in cross section) the longer it will last with a given current of electricity. The upper electrode need not be of any great length; it is well, however, to have it about one-third as long as the lower one, and of half the diameter.

Mr. Staite concludes his specification with the following account of a method of employing currents of electricity "to actuate apparatus for effecting the speedy lighting up and extinction or obscuration of signal lamps in which oil, camphine, or other like inflammable fluid is the illuminating substance employed."

Suppose, for example, there are three such lamps with different coloured glasses, say white, green, and red, which are required to be sometimes lighted, and at other times extinguished or obscured, as is usual on railways, and not all at once, but in a particular order of sequence, or each under particular circumstances only, I effect this in the following manner:—The three coloured signal lamps are placed side by side, or they may be placed one above the other. A sectional elevation of one of these lamps is given in fig. 5. A^a is a bar of metal, having a drop bar, B^b, attached to it. These bars are for the purpose of working three extinguishers, one to each lamp. The figure shows one of these extinguishers as applied to a lamp; the dotted lines in the figure indicate the position which it assumes when raised up. The drop bar, B^b, is attached to a clockwork escapement, the detent of which is alternately retained and liberated by the passage of an electric current, and by its

Fig. 5.



mechanical force raises up the bar, B^b, and causes the light, in whichever lamp it may be, to be put out. The three extinguishers are made to move together, to save the necessity of each being provided with a separate extinguishing mechanism. In the centre of the burner of each lamp is a small ring, *a*, of fine platinum wire, which is so contrived as to touch the wick of the lamp, and the current of electricity being made to pass through this platinum ring, it becomes intensely heated, and thereby ignites the wick of the lamp. I do not restrict myself, however, to the employment of platinum wire, as carbon for this purpose may be used, or any other difficultly fusible material; neither do I limit myself to the employment of a ring of any particular form. The wick may, for instance, be a flat wick, and in that case a straight piece of wire would be suitable for the arrangement.

How the wires from the battery are connected in the last arrangement with the lamps and the escapement, Mr. Staite considers it unnecessary to describe, "as the mode of doing so must be obvious to all who are familiar with the subject of electricity." "It may be sufficient," he adds, "to state, that one wire for the return current will be sufficient for the whole series of lamps and the mechanism connected therewith."

MATHEMATICAL PERIODICALS.

Sir,—Allow me to contribute my mite towards furnishing the information respecting mathematical periodicals required by "Mathematicus" at p. 488 of your last volume. After I have furnished the serials in my own possession, perhaps some others of your correspondents will supply the descriptions of those I have not been fortunate enough to obtain. I am, Sir, yours, &c.,

Thomas Wilkinson.

Burnley, Lancashire, Dec. 29, 1847.

I. *The Ladies' Diary.*

Origin.—This work was "projected and begun" by Mr. John Tipper, in the year 1704, and has been continued up to the present time.

Editors.

Mr. John Tipper ...... A.D.	1704—1713
Mr. Henry Beighton, F.R.S..	1714—1744
Mr. Robert Heath..........	1745—1753
Mr. Thomas Simpson, F.R.S.	1754—1760
Mr. Edward Rollinson	1761—1773
Dr. Charles Hutton, F.R.S...	1774—1817
Dr. Olin. Gregory, F.R.A.S.	1818—1842
Mr. W. S. B. Woolhouse, F.R.A.S. (the present editor)..................	1843

Contents.—An Almanack for the year, followed by answers to enigmas, charades, queries, and new ones proposed for solution. Answers to mathematical questions, and others proposed for solution. Since 1835, a series of valuable appendices has been added to the work containing papers by Gregory, Davies, Woolhouse, Horner, Rutherford, Gilbert, Beecroft, Weddle, &c.

Questions. — The total number of questions proposed and answered is 1778, exclusive of various prize questions not numbered in order. Fifteen are now proposed in each year, but the number has varied at different times.

Contributors.—Among the principal contributors may be mentioned Atkinson, Barlow, Burdon, Crakelt, Dotchen, Evans, Furnass, Gregory, Hellius, Hutton, Moss, Simpson, Turner, Wildbore,

Whitley, Wales; and at present the names of Davies, Woolhouse, Rutherford, Fenwick, Weddle, Beecroft, Hearn, &c., are frequently in its pages.

Publication.—The work is published by the Stationers' Company, on or about the 20th of November in each year.

*** *Query.*—Might not the *usefulness* of the *Diary* be much increased by inserting *two* sets of mathematical questions for solution in each number, viz., a *junior* along with the present senior set; and would not the increased sale of the work more than counterbalance any effects which might arise from a small increase in the size and price?

II. *The Gentleman's Diary.*

Origin.—The first number of this work was published in 1741, its projectors being Messrs. John Badder, of Cossal; Anthony Thaker, Nottingham; William Whitehead, William Butcher, Thomas Mather, J. Granger, George Ingman, and Thomas Peat. Incorporated with the *Ladies' Diary* in 1841.

Editors.

		A.D.
Mr. John Badder, Mr. Geo. Ingman., Mr. Thos. Peat..	conjointly	1741—1756
Mr. Thomas Peat..........		1757—1780
Rev. Charles Wildbore......		1781—1803
Dr. Olin. Gregory, F.R.A.S..		1804—1819
Mr. Thos. Leybourn, R.M.C.		1820—1840

Contents.— Similar to those in the *Ladies' Diary*, but generally of greater difficulty. Since 1835 appendices were added, containing valuable papers by Woolhouse, Davies, Rutherford, Baker, L'Estrange, Jones, Jesuiticus, Palaba, &c. In 1834 the editor discarded the enigmas and charades and substituted scientific notices in their stead; but in 1836 he was again induced to readmit a portion of these "ingenious puzzles."

Questions. — The total number of questions proposed and answered is 1424.

Contributors.—Garrard, Moss, Wildbore, Parnel, Sampson, Dalton, Gough, Skene, White, Wales, Wright, Glendenning, Winward, Jones, Mason, Taylor, &c., besides almost all the able correspondents mentioned under this head in the *Ladies' Diary.*

Publication. — This work was also published by the Stationers' Company at the same time as the *Ladies' Diary.* In 1841 the two works were united, and published under the title of the *Lady's and Gentleman's Diary.* On the occasion of the union, Mrs. Richardson, of Vauxhall, sang their "Auspicious Nuptials;" the Rev. John Hope, of Stapleton, the *laureate* of the *Diary*, composed an "Elegy on the Demise" of the old gentleman; and the facetious Mr. Noah Wilmot indignantly exclaimed:

> "Though unions now are all the rage,
> Who would have thought that *Lady Di.*
> Would at her patriarchal age (137 years)
> Have listen'd to a lover's sigh?"

For my own part I should not have cared how long they had kept *single*, and I think there are many of the same opinion. W.

A SIMPLE PROOF OF TAYLOR'S THEOREM.
BY PROFESSOR YOUNG, BELFAST.

In treating the theorems of Maclaurin and Taylor, in works on the Calculus, it is usual either to establish both by independent methods of investigation, or else to deduce the former from the latter, as a particular case of what is thus made to appear the more general theorem. I think, however, that these two theorems are, in reality, co-extensive; and that it would be quite as allowable to call Taylor's a particular case of Maclaurin's theorem, as to make the opposite assertion. That Taylor's theorem is virtually implied in that of Maclaurin, will be seen from the following axiomatic principle, viz.:

If a function of the form $f(x+h)$ be differentiated in reference to one of the quantities, x, h, and then that one be made zero in the result, such result will be identical with what would arise from making the same quantity zero at first, and then differentiating in reference to the other; that is, expressing the principle analytically—

$$\left[\frac{d^n f(x+h)}{dh^n}\right] = \frac{d^n f(x)}{dx^n}$$

the brackets denoting what the expression they enclose becomes when h is zero.

The necessary truth of this principle will appear obvious from considering that the expression here referred to is the same as

$$\frac{d^n f(x+h)}{d(x+h)^n}$$

of which the value remains unaltered whether we regard x as constant, and h as variable, or h as constant, and x as

variable. In the latter hypothesis we have, when $h=0$, the analytical identity expressed above.

Now, for the development of $f(x+h)$. According to the powers of h, Maclaurin's theorem gives us,

$$f(x+h)=f(x)+\left[\frac{df(x+h)}{dh}\right]h+\left[\frac{d^2f(x+h)}{dh^2}\right]\frac{h^2}{2}+\&c.\dots\text{(A)},$$

And consequently, by the foregoing principle,

$$f(x+h)=f(x)+\frac{df(x)}{dx}h+\frac{d^2f(x)}{dx^2}\frac{h^2}{2}+\&c.\dots\text{(B)},$$

which is the theorem of Taylor. And this mode of obtaining it is not only sufficiently simple for the purposes of instruction, but it also clearly shows that the theorem of Taylor is really comprehended in that of Maclaurin; or rather that the two theorems, viz., (A) and (B), are in fact identical.

The theorem (A) may obviously be established without any other knowledge of differentiation than what concerns positive integral powers of the variable, and thence, as above, the theorem (B) may be derived; and thus, in the exposition of the theory of the calculus, the fundamental principle introduced by Lagrange—and which that distinguished analyst announced without due limitation, as Cauchy and Hamilton have sufficiently shown — may be dispensed with; an important circumstance, inasmuch as this principle, properly limited, involves much lengthy and *subtle* reasoning. The theorem (B) replaces that of Lagrange; it indicates its own limitations, the coefficients spontaneously becoming infinite or zero in the cases of exception; and it serves equally with that of Lagrange to suggest the rules for differentiation in general; the rule for x^n, (n being a whole number,) being previously deduced from the binomial theorem.

EXPERIMENT WITH WRIGG'S SELF-CARRYING RAILWAY-CARRIAGE.

[We have been favoured by Mr. Wrigg with the following account of an experiment recently made with a model carriage, constructed on the plan of which we gave an account in our last Vol., p. 191.—Ed. M. M.]

The experiment was made with the machine in an imperfect state; that is, there was no fresh oil put to the axles, and the rails were used just as they came from the forge, without being polished, either artificially or by use.

The carriage and apparatus, as now made, weighs 140 lbs.

The load placed on the carriage weighed 150 lbs.; the total load being 290 lbs.

I was necessitated to try the machine on a rough-flagged yard, having an ascertained inclination of 1 in 22.

Under these conditions, I passed over a pulley a rope attached to the empty carriage, and found it required a suspended weight of $12\frac{1}{2}$ lbs. to overcome gravity, friction of the drums as well as the rails and moving parts. The inclination being 1 in 22, there is to be deducted $6\frac{4}{10}$ lbs. for gravity,—leaving $6\frac{1}{10}$ lbs. due to the friction of all the moving parts, including weight of carriage. I now loaded the carriage with 150 lbs., making the total load 290 lbs. In this condition it took $21\frac{1}{2}$ lbs. to overcome the gravity and friction; from this is to be taken $13\frac{1}{10}$ lbs. for gravity + $1\frac{1}{10}$, due for friction and drums and the carriage itself $=19\frac{2}{10}$ lbs; which leaves $2\frac{3}{10}$ lbs. for increase of friction for 150 lbs. of a load.

We therefore deduce from this, that if the friction of the rails for 150 lbs. of a load $=2\frac{3}{10}$ lbs., and the friction of the weight of the carriage *including the friction of the drums* be $6\frac{1}{10}$ lbs. $-2\frac{1}{10}$ of this is due to the rail, and 4 lbs. to the drums.

Which for the model would stand thus: 150 lbs. of load require $2\frac{3}{10}$ lbs. to move $=2,240$ lbs. (a ton) requiring 34 lbs. to move or overcome the friction of the rails.

The diameter of a pedestal wheel (in the model) is 3 inches and the axle three-eighths of an inch, while that of a full-sized wheel is proposed to be 18 inches diameter, with an axle of six-eighths inch diameter. The friction would then be reduced to one-third, because while the model wheel made six revolutions, the larger wheel would only make one, and the rubbing surface of the axle of the larger wheel would be represented by 1, while that of the smaller one would

be 3,—that is, the friction would be as 1 to 3; therefore the friction for a load of one ton would be 11¼ lbs.

I have therefore no doubt but with the machine, properly oiled, the rail polished, and roughness of the moving parts wore off, the friction per ton will be below 10 lbs.

Now with regard to the friction arising from the drums, we find 1⅜ lbs. is due to friction of each band in the model; and as the drums of a large machine would be about four times greater than those of the model, it would, I apprehend, follow that the increase of friction would be directly as the breadth of the tire of the drums, which would not exceed four times. The friction therefore for each band, of bearing wheels would be only 5⅝ lbs.

ORGAN PIPES.

Sir,—To answer to some extent the inquiry at page 487, of Vol. xlvii., I inclose the copy of a table of dimensions of organ pipes for a *stop diapason* used by a relative of mine when constructing an organ now many years ago. Your correspondent will find that any note given by an organ pipe requires the pipe to be invariably of the same length for the same note; increasing the area increases the power.

In soldering pewter pipes, your correspondent will succeed in making a fine seam by dipping his soldering-iron in tallow every now and then during the process.

Soldering zinc is more difficult; muriatic acid (spirit of salts) is generally used. I am, Sir, your obedient servant,

December 20, 1847.

Note.—The *stop diapason* is calculated from the C C pipe of my organ; the length of the pipes by the same rule as the dimension of the monochord; the widths by the area of the inside of the pipe, and in the same ratio as the length.

To find the side. As 3,5 is to either of the sides of the great pipe, so is the square root of the area to the side sought.

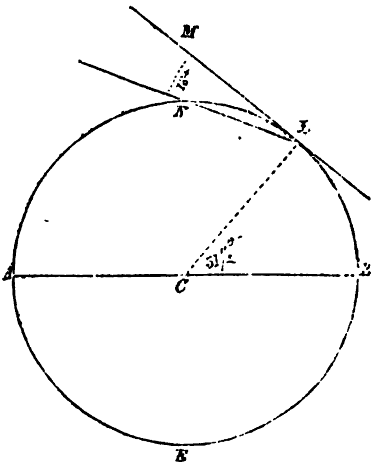
The letters *s* and *f* are used to designate *sharp* and *flat* instead of the usual symbols.

TABLE.

Note.	Length.	Area.	Back.	Side.	Note.	Length.	Area.	Back.	Side.
	Inches.	Inches	Inches.	Inches.					
C C...	44,	12,18	3,25	3,75	E*f*.....	9,14	2,53		
C C*s*...	41,75	11,55			E......	8, 8	2,43		
D D..	39,1	10,82			F.....	8,25	2,28		
E E*f*...	36,56	10,15			F*s*.....	7,82	2,16		
E E..	35, 2	9,74			G.....	7,33	2,03		
F F...	33,	9,13			G*s*.....	6,87	1,94		
F F*s*...	31,28	8,65			A.....	6,6	1,82		
G...	29,33	8,12			B*f*.....	6,18	1,69		
G*s*...	27,49	7,79			B.....	5,86	1,62		
A...	26,4	7,3			C.....	5,5	1,52		
B*f*...	24,75	6,76			C*s*.....	5,21	1,42		
B...	23,46	6,49			D....	4,88	1,35		
C...	22,	6,09	2,29	2,64	E*f*.....	4,57	1,26		
C*s*...	20,87	5,70			E.....	4,4	1,21		
D..	19,55	5,41			F.....	4,12	1,14		
E*f*...	18,28	5,07			F*s*....	3,91	1,08		
E...	17,6	4,87			G.....	3,66	1,01		
F...	16,5	4,56			G*s*.....	3,43	0,97		
F*s*...	15,64	4,32			A.....	3,3	,91		
G..	14,66	4,06			B*f*.....	3,09	,84		
G*s*...	13,74	3,89			B.....	2,93	,81		
A...	13,2	3,65			C.....	2,75	0,76	,8	,94
B*f*...	12,37	3,38			C*s*.....	2,6	,71		
B...	11,73	3,24			D.....	2,44	,67		
C...	11,	3,04			E*f*.....	2,28	,63		
C*s*..	10,43	2,85			E.....	2,2	,6		
D..	9,77	2,7			F.....	2,06	,57		

THE DIP OF THE MAGNETIC NEEDLE.

Sir,—It appears to me that the following circumstance may possibly help to explain the mystery of the dip of the magnetic needle, the north point of which, I believe, in London, dips 72°?



In reference to the previous diagram, let AEBLNA be a section of the earth, the cutting plane passing through the centre, C, the plane of the equator being represented by the line, AB. Let L be the latitude of London (viz. 51½°,) and N the North Pole. Join LC, and draw LM perpendicular to it, the latter being a tangent to the circle, and representing the horizontal level at London. Draw a right line from L (London) to N (the North Pole itself,) and the angle NLM = 18°, which is the exact complement of 72°, the dip of the magnetic needle.

I am, Sir, yours, &c.,

M. M. F.

CASE IN MENSURATION.

Given a circular-shaped vessel;—the top diameter being 225 inches, and the bottom diameter 150 inches; and the inside perpendicular height 275 inches.

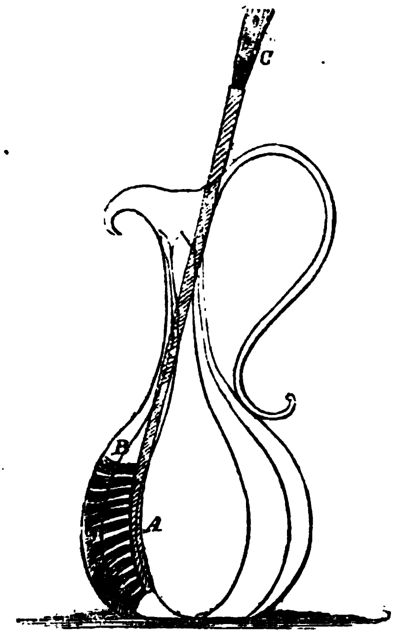
Required two vessels, similarly shaped, the one to hold exactly an imperial pint and the other an imperial half-pint, both having their diameters and heights in the same proportion as the vessel given. The answer to be in inches and decimals, with "*proof.*"

J—N M—S.

Battersea, December 27, 1847.

TRING'S REGISTERED DECANTER BRUSH.

[Registered under the Act for the Protection of Articles of Utility.]



The above engraving represents a very simple contrivance for effectually cleansing decanters, claret jugs, &c. It consists in the curvilineal shape given to the back of the brush-handle, A, and the angles at which the bristles, B, are consequently inserted, whereby it is rendered applicable to the cleaning out of decanters, jugs, and bottles, of almost every form in general use. A knot of hair, C, is fixed into the end of the handle, for the purpose of cleaning the lower portion of the sides and bottom of wine bottles, &c.

ON VAPORISATION, (IN CONTINUATION OF THE ARTICLES ON "THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.")

(Continued from page 31.)

The influence of atmospheric pressure on the "Boiling point," is, as we have before remarked, more fully illustrated by popular writers than any other parts of the subject—many of which are of much more real importance. And yet this influence is, notwithstanding, but

imperfectly understood, after all, if some of the experiments on record can be depended upon as accurate. In the *Philosophical Magazine* for August, 1840, Mr. Coathupe has given an account of some experiments made by himself in the highly heated atmosphere of a glass-house. The only one of the experiments with which I am now directly concerned, is the following: "A small black iron cylindrical pan filled with water was placed upon a thin iron shelf, which had been fixed against the pillar and close by the side of the thermometer. It was reasonably anticipated that water thus placed in a temperature of 320° to 325° would boil; but after waiting until the half of it had evaporated, it showed no tendency to ebullition. The top of the iron pan was now covered with a pane of window glass, and in a few minutes it boiled violently."

It is not stated what was the temperature of the water in the pan, for the thermometer, which stood at 320°, was not in connection with it, but merely in the same part of the apartment; but whatever might be the temperature of the water, the fact that the pane of glass when placed over it, caused ebullition, is not a little curious. The only effect which, according to known laws, such an interposed plate could have, would be the reflection of a considerable portion of any heat transmitted from the water on one side and the air of the room on the other; unless indeed it fitted so close to the vessel as to interrupt the communication between the air inside and outside. Before reasoning about the thing any more, however, it would be well to have the experiment carefully repeated; and I trust some of the readers of the Magazine may be induced to not only repeat this experiment, but to go into a regular course of experiments on the subject; for an immense deal remains to be done, even with regard to so common a phenomenon as the boiling of water, before it can be understood. There are a set of persons always ready to explain any new or remarkable fact, which those who really are competent to judge, are puzzled at. As Franklin says with regard to those who saw his experiment, "Those who are but slightly acquainted with the principles of hydrostatics, &c., are apt to fancy immediately that they understand it, and readily attempt to explain it; but their explanations have been very different, and to me not very intelligible. Others more deeply skilled in those principles, seem to wonder at it, and promise to consider it."

The term "Evaporation" is generally used with reference to vaporisation of liquids at temperatures lower than their boiling points, and is also generally considered to proceed entirely from the *surface* of the liquid, in opposition to "boiling," in which the whole mass is affected.

By what experiments this has been *proved*, I know not. It is no doubt true, that the rapidity of the evaporation may be greater the larger the surface exposed to the air; and also that no *visible* bubbles of vapour are formed, as in boiling. But neither of these facts prove that it is only the uppermost layer or stratum of fluid which passes into vapour.

Again: when water is converted into steam under higher pressures and temperatures than the ordinary atmospheric pressure and boiling point, there is (under certain circumstances) no appearance of *boiling*. There is an experiment of Cagniard Latour which throws some light on what takes place in these circumstances. Suppose we have water in a closed glass vessel, so that the steam cannot escape, but is accumulated on the surface of the water, exerting a continually increasing pressure on it: the application of heat no longer produces detached bubbles as under the ordinary atmospheric pressure; but the vaporisation goes on quietly, as in evaporation at lower temperatures than the boiling point. Now the tendency of the heat, as before, is to gradually expand the water particle, W, until at a certain stage the cohesion between its constituent molecules, V, is destroyed, and the particle, W, is changed into a number of particles, V; such that the vapour so formed has the pressure corresponding to that exerted on the surface of the fluid. But in ordinary boiling this last pressure is uniformly the same throughout the whole process; viz., the atmospheric pressure; and when the whole mass of water is put into such a state or stage of expansion that any further addition of heat can no longer expand the water *as water*, but must begin to send off the particles, W, into steam, at this point *boiling* commences. It must be observed,

that from the moment the heat is first applied, the particles nearest to the source of heat are gradually expanded; but they are compelled *to communicate* this incipient expansive energy to the other particles surrounding them. In other words, the WHOLE MASS must be raised up to a certain *temperature*, before *any one* particle can go off into steam; for the *temperature* is but an index of the state of pressure in the fluid mass. If now instead of one and the same constant pressure on the surface, we have *a continually increasing pressure*, the whole mass of water must be continually raised to a corresponding temperature, or put into a corresponding *state of expansion* before *any one* portion of it can be converted into a bubble of steam. Now the increasing pressure on the surface is itself the very consequence of this formation of vapour. So that the two things depend mutually on each other: the particle of water cannot pass into steam until the whole fluid mass is put into a certain state, and this very state itself depends on the conversion of these particles into steam. But there is a limit in the nature of each fluid to this process: at a certain point or stage in the expansion of the whole mass, the slightest further addition sends off, not a portion merely, but the whole mass of water into vapour.

The following account of Cagniard Latour's experiment is taken from Biot's "Precis Elémentaire de Physique:"

"In investigating the effects of a high temperature on liquids enclosed in a vessel capable of resisting the expansion of their vapours, M. Cagniard Latour remarked, not without surprise, that small tubes of glass closed by the heat of a lamp, formed an apparatus much better capable of resisting internal pressure than one could naturally have supposed. He enclosed, therefore, in vessels of this sort different liquids, such as water, alcohol, sulphuric ether, &c., in sufficient quantity only to fill a greater or less space in the vessel, and afterwards heated them with all the precaution necessary, in order not to break the tubes by too sudden an elevation of temperature. The enclosed liquid, on being heated, gradually dilated, as was to be expected; but beyond a certain limit of the expansion, when it was yet very far from filling the whole capacity of the tube, all appearance of liquid vanished, and the tube contained nothing but a transparent vapour, which the slightest depression of the temperature instantaneously precipitated in the form of a copious rain. By causing the pressure of these vapours to act on a given volume of air, M. Cagniard Latour determined their elastic force, and thus arrived at the following results:—Ether is expanded into vapour in a space less than double of its volume in the liquid state, and its vapour then exerts a pressure of 37 or 38 atmospheres. Alcohol is wholly converted into vapour in a space rather less than three times its liquid volume, and it then exerts a pressure of 119 atmospheres. Lastly, water can be converted into vapour in a space about quadruple of its original volume, its temperature being under these circumstances but little different from melting zinc."

Such is Biot's account of these experiments—some of the most important, perhaps, which have ever been made on this subject. As an example of the imperfect way in which experiments are so frequently reported, and of the erroneous views which such accounts are likely to give, I shall now give some extracts from the original papers of M. Cagniard Latour, in the "Annales de Chimie et Physique," tomes xxi. et xxii. (2me serie.) (Biot *has* given the reference to the original account: would that all writers did the same!)

"One of the tubes in which alcohol had been put to the amount of about two-fifths of its capacity was heated with the necessary precautions, to prevent breakage; as the liquid dilated, its mobility became greater and greater. *The liquid, after having become double of its original volume*, completely disappeared, and was converted into a vapour so transparent that the tube appeared perfectly empty; but letting it cool for an instant, a thick cloud (nuage très-épais) was formed, after which the liquid reappeared in its primitive state. A second tube, about half of whose capacity was occupied by the same liquid, presented a similar result; but a third, in which the liquid occupied rather more than this proportion, broke." * * *

"*All the tubes in these experiments had been cleared of air before being closed:* on repeating the experiment with tubes in which the air was left re-

maining, similar results were obtained; the progressive dilatation of the liquid was even more easily perceived in these latter, in which there *was no inconvenient ebullition, as there was in the others.*"

This circumstance of the ebullition in those tubes where a vacuum existed is of considerable importance, and ought to have been stated by Biot. In saying, however, that *a vacuum* existed above the liquid in these tubes, a wrong expression has been used, inasmuch as the liquid would necessarily give off a considerable amount of its own substance in vapour as soon as the air was extracted at the beginning of the experiment, as in the well-known experiments of Dalton. In the 22nd volume of the "Annales," M. Latour has given some tabular results containing the temperature and corresponding pressures—but has not given the quantities of heat, nor the dilatation of the liquid corresponding to each pressure, which data would have been of the highest value. There is in these tables a very great irregularity and apparent absence of all "law" in the successive pressures, which the experimenter himself attributes "à quelques inexactitudes, qui se seront glissées dans les experiences, quoiqu'on ait cherché à y apporter tout le soin possible." "In the first experiment ether passed into the state of vapour at 150 degrees (Réaumur) and produced a pressure of 37 atmospheres. Sulphuret of carbon, which is nearly as volatile as ether, did not however pass into vapour until the temperature was 220°, and pressure about 78 atmospheres, *i. e.* double of the ether. This result is the more remarkable, in that the capacity of the tube in which this quid was enclosed was rather larger in proportion to the volume than for the ether."

Lastly: another very remarkable result was, that the increment of pressure for a given increment of temperature was much greater *after* the whole liquid was vaporised than before; but the great irregularities presented by the tables are such as to render it very desirable that these experiments should be carefully repeated, and that in addition to the temperatures and pressures, the dilatations of the liquid and corresponding quantities of heat applied should be observed.

I extract the following sentences from the article on "Heat" in the *Encyclopædia Metropolitana*, where they are translated from a memoir by Gay-Lussac, in the "Annales de Chimie:" "This result, that alcohol and sulphuret of carbon dilate equally, and produce the same volume of vapour, is certainly very remarkable; it would seem to warrant the presumption that there is an intimate relation between the dilatation of a liquid and the expansion which it undergoes when reduced to a state of vapour. This ratio ought to be independent of the density and the volatility of the liquids, or, at least, ought not to depend upon these properties only, since in alcohol and sulphuret of carbon they differ so widely. Ether and water present no similar appearance; only we perceive that ether, which of the four liquids produces the least vapour, has the greatest dilatation; and that water which produces the greatest volume of vapour, dilates the least." Gay-Lussac is here referring to some of his own experiments, and the volumes of vapour referred to were those produced at the temperature 100° centigrade.

The connection between the dilatation of different liquids by heat whilst in their liquid state, and the volumes of their vapour, is a subject worth inquiring into. If the preceding experiments of Gay-Lussac are really instances of a general law, then the liquid which dilated least *as a liquid* expands *most* when converted into vapour for a given range of temperature. But here again, as in all other cases, we want to know the quantity of heat necessary to produce these dilatations, and not merely the corresponding degrees of temperature.

The dilatation of the liquid mass so visibly manifested in Cagniard Latour's experiments, very clearly illustrates what I have already alluded to as one step in the explanation of the process of vaporisation; but as this view of the process has not been anywhere brought forward that I am aware of, it will be as well to state it again here. The expansion of any fluid particle and its conversion into vapour implies a state of pressure, which pressure (by what *means* I do not pretend to say, whether by the vibration of a pervading elastic medium or any other,) is communicated to the surrounding particles of the fluid mass, so as to put them into a *similar* state. This pressure, and consequent expansion, however, is not confined to the *fluid* mass to which the

particles we are considering belong, but is propagated to the mercury in the thermometer-tube. This process of propagation will of course require *time*, however short. The *time* occupied in expanding and vaporising the particle under consideration will obviously depend on the *resistance* to such expansion, which resistance arises from both external and internal causes. The *internal* resistance to expansion depends on the nature of the liquid itself. The *external* resistance depends on the pressure exerted by the atmosphere, or confined vapour, on the surface of the fluid, and on the weight of the superincumbent column of fluid. The greater these resistances, internal and external, are,—the longer time it will take for the heat to overcome them; and during this time the pressure can be more effectually propagated throughout the surrounding fluid and the mercury, so as to dilate them—the dilatation of the mercury being what is termed the increase of *temperature*.

Let us apply these considerations to different cases; and first, to the boiling of water under the ordinary atmospheric pressure. At the beginning of the action of heat, the internal resistance in any one particle on which the heat acts is very great—the time necessary to overcome this resistance, so as to dilate the water particles, is, comparatively speaking, long, and the pressure or reaction is propagated so fully to the mercury in the thermometer as to cause very great dilatation in it. As the expansion of the water particle, however, approaches nearer and nearer to the limit of its cohesion, the internal resistance becomes less and less, and the corresponding reaction on the mercury feebler and feebler: in other words, the increase of temperature in a given time becomes less and less. When the limit is attained there is no more reaction, no more dilatation of the mercury; the thermometer is stationary, and the boiling process alone goes on. Increase the atmospheric pressure on the surface, and of course it will take a longer time to reach this limit—the reaction and consequent dilatation of both water and mercury is prolonged. Or, confine the issuing steam or vapour, (as in Cagniard Latour's experiments,) and the same results follow, viz., increased dilatation of the fluid mass and of the mercury.

It will be observed that the *water* (or whatever be the liquid in question) is affected by this reaction, just as well (though not *to the same degree*) as the mercury of the thermometer; in fact, the liquid mass is its own thermometer. But a limit comes even to this dilatation of the liquid—a moment in the process arrives at which the whole fluid mass has acquired the greatest dilatation which is consistent with its preserving the liquid state. Any addition of the heating action beyond this sends off not a portion only (as in ordinary boiling) but the whole mass altogether into vapour. The surprising and unexpected circumstance of the *whole* liquid mass being thus suddenly driven off into vapour, instead of going off gradually in small quantities, is thus easily comprehended. Under the usual, and, comparatively speaking, small pressure of the atmosphere, the pressure required to vaporise the fluid-particle already on the extreme verge of expansion, is but small; and (what is more to the purpose) the conversion of this particle into vapour *will not increase* the pressure on the surface; whereas, in these last experiments it will do so, by adding to the already confined vapour. And, finally, the expansion of the liquid reaches such an extent, and the diminution in the mutual cohesion is so rapid, that the re-action necessary to transform the *whole* liquid into vapour is no greater than that requisite to convert a small portion of it into vapour; just as in any tottering structure where you cannot touch one part without bringing the whole down together.

The fluid, the vapour confined in the space above it, and the mercury in the tube, are, in fact, systems of particles differently constituted; and the problem we have to solve is the mode of propagation of pressure and expansion from any point in one to the other systems. The actual manner in which this propagation takes place is unknown, but certain effects of this action are easily observed and measured; and the fundamental mechanical principle, that any given quantity or supply of heat is, under all circumstances, equivalent to and productive of a certain amount of "work done," or resistance overcome, may serve, I think, to explain satisfactorily several of these phenomena.

It would not be difficult to express, by means of differential equations, the relations which must necessarily exist between several of these observed results and the unknown molecular forces which produce them; but such equations would probably lead to no useful result which cannot be more readily and simply attained by methods of less pretension but more real utility. Amongst these methods, that of employing the *mean* pressure multiplied by the number of units of space through which it acts, instead of the corresponding integral, deserves to be noticed. For all useful purposes, and for every object attainable in the present state of our ignorance of the nature of molecular forces, this method is very much superior to the absurd method of using unknown functions of the distance to express the "Law of Force," merely for the sake of giving the investigation a profound look: thus sacrificing clearness of conception and facility of interpretation to a ridiculous show.

The subject of Evaporation, and, generally, of Dalton's experiments, remains to be considered in a future paper.

(*To be continued.*)

THE CAUSES AND EFFECTS OF EXPLOSIONS IN STEAM ENGINES INVESTIGATED; AND THEIR RESULT FROM AN EXPLOSIVE PRINCIPLE DIFFERENT FROM THE FORCE OF ELASTIC STEAM DEMONSTRATED; WITH AN EASY AND CERTAIN MEANS OF PREVENTING ITS DESTRUCTIVE EFFECTS, AND REDUCING IN GREAT PART THE ENORMOUS WEIGHT OF ENGINES. BY JOHN WILDER, NEW YORK.

(Concluded from page 36.)

No instance of the explosion of an engine boiler, except when the engine was at work, has come to my knowledge, and the breaking of the working gear at any other time is impossible, and equally impossible that the gear should be broken except by action within the cylinder, which must be referred to the decomposition of steam within the cavity of the valve chamber and clearance of the piston, and the consequent setting free an explosive power which has no known limit of action. The explosive action within the boiler is evidently induced by causes which operate therein, the most obvious of which is a deficiency of water and a consequent elevation of the temperature of the contained steam, above its proportionate density; for steam properly generated contains always an amount of water proportionate to its temperature; but if its expansive force be greatly increased by heat only, it is plain that the heat of expansion (so to speak) will be most readily given off at the slightest cause: hence if there be a deficiency of water and the boiler and steam therein overheated and a steam valve be opened, the caloric which is greatly in excess and very slightly combined, must move towards the cavity of the valve chamber with a motion not unlike that which takes place in the water of a canal if a gate be suddenly opened; but with this difference, the velocity of caloric is almost unlimited compared with water.

The movement of the elementary fire within the boiler and steam pipe must continue with the further opening of the steam valve, and may therefore be met by a counter movement resulting from an explosive action within the valve chamber; the effects which may result from the meeting of the opposite currents, should be those due to the conjoint velocity at the instant of impact. That they are really so, is evident from the almost unlimited violence of explosive action in numerous instances.

A short time before the wreck of the *Atlantic*, the first-class steamboats *Worcester* and *Traveller* were together at the dock, one with a broken shaft, the other a disabled crank. Not long afterwards the *Cleopatra*, belonging to the same owner, broke the centre pivot of her walking beam, although of prodigious strength, much exceeding 500 lbs. to every square inch of her piston. In June, 1847, the engine of the *Traveller* was completely wrecked, the great beam being broken in two, and the cylinder and condenser shattered from top to bottom.

The cylinder of the *Traveller* was 52 inches diameter. The stroke 11 feet; the capacity of the cylinder, 162 cubic feet; of each valve chamber 5 cubic feet; of cylinder and valve chamber together, 167 cubic feet, nearly. The steam pipes lead from steam chimneys, which at the distance of a few inches inclose the proper chimneys to the height of 6 or 8 feet above the main boilers. The strength of the beam was estimated much above 500 lbs. to each square inch of the area of her piston, and therefore strong enough to have turned her wheels a hundred revolutions the minute without risk of breaking. The beam when taken out was laid close to another of similar make and strength; the main strap of wrought iron had been broken short off, although its estimated cohesive strength was not less than 1,000,000 lbs. Both these beams, and most others, were greatly exceeded in comparative

strength by the beam of the *Oregon*, which was likewise broken.

There was no acceleration of the blowers in the *Traveller*, nor anything else unusual in the management of the fires. She had been under headway a few minutes at only ordinary speed; there was only the common load on the safety-valves; and from their position, elastic steam of greater force than due to that load could not have traversed the steam pipes and reached the cylinder. Under all the circumstances, not the least remarkable of which was the instantaneous occurrence of the breaking and as sudden termination of the explosive force; it was not easy to ascribe it to the force of steam, and it was affirmed that there was "an old crack in the beam," but of which I could not in close and repeated examinations discover any indication whatever. The question again recurred, by what force was that "old crack" produced? It would not do to admit that it resulted from an explosive power which had no known limits; for against such power there was no means of prevention or security known.

Four days after the wreck of the *Traveller's* engine the *Columbus* wrecked hers; one of the shafts only was disabled, the beam escaping without much damage. However, one part is not much more liable to fracture than another; and in truth the breakings have been frequent enough in all parts of the engine, to bring them up to one standard for strength.

Shortly after the accident to the *Columbus*, the *North America* broke her beam on the passage between New York and Albany; and not far from that time, part of the piston of the *Isaac Newton* was broken in two, across the centre; it was a spheric segment of cast iron, 6 feet 9 inches diameter and 1½ inches thick, and further strengthened by very strong flanges, rim and socket to receive the conical end of the piston rod, on which, apparently, the piston had been suddenly forced as the immediate cause of breaking.

On the 11th of September the *Oregon* disabled her beam for the second time on her passage up the sound at ordinary speed. The centre pivot was disabled, one of the journals being broken off, leaving a spherical cavity in the larger centre part. The pivot was of wrought iron, 3 feet 2 inches between the bearings, nearly half of that length being included in the centre socket of the beam; diameter of the centre part 12 inches, of the journals 9 inches, length of journals 12 inches. Similar pieces of wrought iron, similarly loaded, exhibited a strength compared with which the pivot of the beam would have worked safely had the load on the piston been equal to 1,000 lbs. for every square inch of its area, the force of elastic steam only being concerned: as the pivot was the part to fail on trial, it is sufficiently proved that all the working parts of the engine were equally strong. Even pieces of white pine, similar to the pivot and similarly loaded, exhibited a comparative strength, of at least 150 lbs. to each square inch of the area of the piston, which was 6 feet in diameter, and the force of elastic steam upon it cannot be presumed to have exceeded one-fourth of 150 lbs. for each square inch of its area.

The breaking was equally sudden with that of the *Traveller*, the first notice of which was the crash of the falling beam. There was no movement of safety-valve—no vehement hissing of strong steam, nor any unusual stir of water behind the wheels to give the least intimation of the enormous force exerted between them. Nor in any other reported case has there been more previous warning or any prolongation of the immense force which produced these effects beyond the single instant in which it was exerted.

To these instances may be added that of the steamboat *Alida*, on her passage down the North River, October 3: the breaking imputed to a defect in the iron of the beam; the fracture the only possible evidence of such defect. But it is painful to witness this impeachment of able and faithful workmen, and experienced and careful engineers, solely to avoid acknowledging the action of an explosive power within the cylinder.

It has been noticed before, that in most engines the area of the great piston is to the area of the opening of the steam valve by which steam is admitted into the cylinder, as 25 to 1, (a little variation is not material,) and therefore to produce the sudden and violent motion of the piston which could break connecting rods, beams, cranks, &c., would require a prodigious force of steam in the boiler, which would need to be red hot. But it is the work of time to produce such force; the blowers must turn with extra speed, and there must be an extra supply of fuel in the furnaces, such as never has been made available under the greatest excitement of competition; and, after all, the position of the steam valve would effectually check any current from the boiler, while the pressure of steam which might be exerted on the piston, would be equally exerted to lift the safety valve; and therefore to limit the force on the piston to the load on the valve.

The safety valve has been the great dependence for security against the force of steam, and also for testimony to screen the

engineer from the laws, which would otherwise adjudge him a felon in case of loss of life from explosion, and therefore not much likely to be overloaded, as has been often said, but never proved. It may be justly questioned whether it has ever been known to be loaded to half the calculated strength of the boiler in any case where explosion has occurred.

In the explosion at Baltimore, if the boiler was of quarter inch iron, the cohesive strength to resist bursting laterally was equal to a force of elastic steam of 1,500 lbs. on the square inch, and the force which rent it asunder endwise was not less than 3,000 lbs. on the square inch.

Moreover, if the force of steam be increased, the density of water and the laws of its resistance remain unchanged; the boat may move with greater speed and the wheels may revolve more rapidly, without much additional strain on the machinery, but not without working off a much greater amount of steam, and thus rendering ineffective any force of elastic steam that could endanger the breaking of the engine.

Two chain and one hempen cables sustained the *Atlantic* in the open sound for 23 hours of a terrible gale; yet their cohesive strength was less than a force of 50 lbs. to each square inch of the area of her piston, but the force to be sustained, resulting from the force of the waves and the pitching of the boat, far exceeded any resistance of water to the motion of the paddle-wheels; nevertheless, the working parts of her engine were equal to a force of 500 lbs. to each square inch of that area. The calculated strength of the largest chain cable of the steam-ship *Washington* is not equal to a force of 40 lbs. to each square inch of the area of her pistons, but is strong enough to hold her in a gale of wind, although her whole weight when fully loaded is little less than 3,000 tons, and therefore the momentum of this immense weight, put in motion by the force of the waves, must greatly exceed any possible resistance of the water to the motion of the wheels; nevertheless, much of her machinery is equal in weight and strength to a force of 700 lbs. on every square inch of the area of her pistons, and must be considered as not more than equal to the explosive force occasionally exerted on them; although if the force of elastic steam was only concerned, six parts in seven of that weight would be for all purposes of navigation and security worse than useless.

The elastic force of steam can, within the boiler, be completely regulated by the safety valve, which may be so constructed that the force can never exceed a certain limit; and that in a condensing engine, it is generally agreed, ought to be below 30 lbs. to each square inch of the area of the piston, from considerations of advantage as well as of security, and the working load, if measured by the resistance of the water to the motion of the wheels, is usually considerably lower. Hence if there was no force but that of steam concerned, the working parts of the steam engine might be made of one-sixth or one-eighth of their present weight and strength; but its present weight and strength (not less than 600 or 800 lbs. to every square inch of the piston,) proves, most conclusively, the action thereon of an explosive force of corresponding intensity which does not proceed from the boiler, but originates within the valve chamber and cylinder, and by a process not unlike that which obtains when fire-arms are discharged with the muzzle closed. Steam from the boiler, when of great force and at a high temperature, is partially decomposed when passing into the cavity of the valve chamber; and as of its constituents caloric alone can possess an inherent power, the effects produced must be ascribed to its action, for steam of a force of 40 or 50 lbs. per square inch of the piston cannot "in the twinkling of an eye" break in pieces beams, cranks, shafts, &c., of a strength of 600 or 800 lbs. to each square inch of that area.

It has been shown how nearly the conditions, present in the atmosphere when the electric fire is liberated, resemble those which obtain in the valve chambers of condensing engines at the opening of the steam valve.

The apparent resemblance which obtains in the valve chambers of high pressure engines and in fire-arms, which are discharged with the muzzle closed, is perhaps greater; in explosive violence there is little difference. In May, 1847, the steamboat *New Hampshire*, on Arkansas River, blew up with a violence which could hardly be exceeded had her boilers been filled with gunpowder. They were rent asunder and the parts projected to a great distance in different directions; heavy articles on deck were thrown ashore and into high trees, and the boat herself parted amidships and sunk.

But the circumstances which established the analogy between the explosions of steam engines and those which result from the action of explosive substances, as clearly indicate the means of prevention.

In every known instance, the force and extent of explosive action has a direct relation to the amount of the explosive substance; the force of discharges from electric

and galvanic batteries, is always greater or less in direct proportion to the extent of the batteries from which the discharges are made.

Gunpowder has been subjected to the most careful experiments; and the result of innumerable trials demonstrates the general law, that "when balls of the same weight are fired with different quantities of powder, the velocities communicated to the balls are in the subduplicate ratio of the quantities," and the same general law obtains of necessity with all other explosive substances; and universally the effects produced by explosions are in direct proportion to the amount of the explosive compounds and the intensity of their action; but no simple substance is known to explode, nor is there any known explosive action without a concurrent decomposition of the explosive compounds. But it has been proved that explosions in steam engines are the consequence of the escape of elementary caloric from its combination with water or its vapour, and result directly from the removal, in the valve chamber of engines, of the compressing force which kept up the combination; for when the steam valve is opened, the steam which passes into the valve chamber has free space to expand and the caloric to escape, but that escape, and the further opening of the valve, must diminish in a degree the compressing force, and be followed by a further escape of caloric; but its amount and consequent action must depend more or less on the temperature and expansive force of steam within the boiler. The occasional violence of its action is shown by the prodigious strength of the beams, cranks, &c., which are sometimes broken.

It is apparent from all considerations, that if the valve chambers be disused, and the steam let directly through the ends of the cylinder, the smallest clearance of the piston from the end, which does not admit its touching, will be the only vacant space for expansion and escape, and this need not be a hundredth part of the space in the valve chamber, and of consequence the explosive action cannot exceed the hundredth part of its present violence.

The steam valve, from its purpose, must always open towards the boiler, and is therefore held to its seat by the force of steam without inconvenience. Hence valve chambers, or nozzles, as they are commonly termed, are only required to hold the eduction valves by the force of steam; apparently on the idea that the same species of force which holds tight the safety valve would not be equally convenient and effective in holding tight the eduction valves.

Whoever has observed the working of the common toggle-joint, or angular lever printing press, has seen a single man at rapid intervals produce impressions requiring a force more than sufficient to hold to their seats the eduction valves of the largest engines; at the same time the impressions are made with a regularity and precision as great as could be required in working the valves. But for the working of valves there are more convenient forms of the toggle-joint or angular lever, in which, with but inconsiderable motion, the weight of one of the present lifting rods would be more than sufficient to hold to its seat the largest valve which could be required; and more convenient modification of the lever may result from its application to the holding of valves, or methods even more convenient invented. That in its present form it would completely answer the purpose of holding and working the valves much better than the present method, the power platten press, which makes its impressions by thousands, with unerring precision and certainty, is of itself a most perfect mechanical demonstration.

Sliding valves or gates cannot be made without too great a vacancy, and they are in no way necessary or advantageous.

The valve seats should be let directly into the ends of the cylinder, with the least interval between them and the piston, when at the end. With the removal of the explosive action, the engine may be made to work with great nicety and precision, and a single line would be sufficient for the clearance of any piston of moderate dimensions.

Against the force of steam in the boiler, unconnected with the working of the engine, the safety valve is, when properly loaded, a perfect safeguard; with the removal of the unnecessary, wasteful, and dangerous nozzles, it becomes an equally perfect security when the engine is at work, and at no other time are explosions known to take place.

Of itself, and unattended with explosive action, steam is the most elastic, yielding, and manageable of all prime movers, and the weight and strength of the working parts of the engine need never exceed the amount required by a force double of the highest load on the safety valve. Hence, with the removal of the causes of explosive action, and with the advantage of the reduction of friction, weight of materials, and better construction, the weight of the working parts need not much exceed one-tenth of the present amount; and the boiler might undergo a corresponding reduction; but with such reduction of the weight of the engine, its application to carriages on common roads becomes perfectly feasible, as well as to corresponding purposes, civil and military. It is manifest that armies cannot

be arrayed against a charge of locomotives; and the saving of human life from this reason may be far greater than by the prevention of explosions, which have cost a life for every day of the past year.

THE "BANSHEE" MAIL STEAMER.

On Monday last this vessel, which is destined for the Liverpool and Holyhead post-office station, made a trial trip down the river. She has been designed by Mr. Lang, jun., assistant-master shipwright, Woolwich, and fitted with engines of 250 horses-power, by Messrs. Penn and Co. From Blackwall the *Banshee* went down the river about 14 miles below Gravesend. "Her speed," says the *Times*, "the easy motion in every part, the stiff manner in which she answered her helm when turning, and her qualities altogether, were the admiration of all on board, and she was admitted to be the fastest steamer yet tried. The official reports will substantiate this statement; the *Carradoc* iron steam vessel for the same station being reported very nearly 17 statute miles, and the result of the trial of the *Banshee*, three times up and twice down, giving a mean of 18·50 or 18½ statute miles. The speed, with the wind and tide, was fully 21 miles per hour, the measured mile having been run in 3 minutes 17 seconds the first time, and 3 minutes 15 seconds the second, and in 4 minutes 20 seconds against wind and tide. The engines made from 30 to 31 strokes per minute of 5 feet each, and were in excellent working order."

INQUIRIES AND ANSWERS TO INQUIRIES.

Electro-Magnets and Electro-Magnetic Engines.—"Can you give me any information respecting the power obtained from *hollow* compared with *solid* electro-magnets? and whether the power increases in a direct or an inverse ratio with their size? I have for some time been of opinion that, for certain purposes, electro-magnetic power might be substituted for steam. The experiments hitherto tried have not, certainly, gone far towards establishing that superiority,—the weight of iron in the electro-magnets having been an insuperable objection. Besides, I do not consider that the best arrangement was adopted in the early electro-magnetic engines. I have contrived the mechanism of an engine, which I am bold enough to imagine would go far towards overcoming many of the difficulties formerly experienced; but, to the present time, have not been enabled to test this arrangement. If hollow magnets should be considered equally eligible with those of solid metal, I do not hesitate to assert that an engine of amazing power can be produced with my arrangement; and it would form the stepping-stone of improvements tending to render the apparatus sufficiently complete to compete with steam for locomotive and other purposes. I am, Sir, yours, &c., *J. F.* Brighton, Jan. 6, 1848." Coulomb and others have clearly ascertained, by positive experiment, that it makes no difference whether an electrified body is solid or hollow, thick or thin. The electricity is generally supposed to be diffused over the surface only; but whether the distribution is equal on every part of a surface, and whether it penetrates beyond the surface, are questions that have not yet been fully investigated. Again; as to the influence of "size:" Dr. Scoresby has shown that the magnetic powers of bars, the same in all respects excepting as to thickness, are *not* proportional to their respective masses, but that the ratio of augmentation of power *diminishes* as the thickness increases.—(*See* Dr. Scoresby's "Magnetic Investigations," Part I., p. 35.) And we do not suppose that there can be any difference in this respect between natural magnets and electric magnets.

Double Achromatic Lenses.—"I am desirous of some information on the method of calculating the radii of curvature to be employed in the construction of a double combination of achromatic lenses, such as those made by Voigtländer, Lerebours, and others, for the Daguerreotype Camera Obscura. If I mistake not, the double combination owes its great superiority over a single achromatic lens (of flint and crown glass combined,) to the better correction of the spherical aberration. I am acquainted with the formulæ for calculating the curvatures of the different surfaces of an achromatic lens, but I do not know how to make the aberration of the second achromatic in the combination of two correct that of the first, because I do not know how to make the lens have any given amount of spherical aberration, either + or −, which, I believe, is the condition required for the correction of the aberration. For, if the rays falling on the circumference of the lens be refracted to a point whose distance from the lens is nine-tenths that of the true focus, I imagine that a second lens, which, used alone, would refract the same rays to a point eleven-tenths the distance of the true focus from the lens, would, when applied in combination with the first, refract them accurately to one focus. If this conjecture is correct, then the problem would be reduced to this:—To make an achromatic lens which shall have any given amount of spherical aberration, either + or −, according as the aberration of the first lens increases or diminishes the focal distance. I hope some of your mathematical correspondents will be able to furnish me with the desired information, as I see that mathematical difficulties are constantly explained and overcome in your pages. Trusting that you will excuse the trouble, I am, Sir, yours, &c., *T. C. S.* Leeds, Jan. 5, 1848."

Fire Hose.—"Will you be good enough to inform me where the patent hose for the use of fire extinguishing is prepared or manufactured? A Mr. Vouch is, I believe, the patentee. I am, Sir, yours, &c., *Daniel Graham.* Preston, Jan. 7." The article inquired for by Mr. Graham is the Woven Linen Hose (*Vaucher's*. not *Vouch's* patent,) now pretty extensively employed throughout the country. The agent for the sale of it is Mr. Merryweather, 63, Long-acre.

Wool-Combing Machines.—"Which is now considered the best plan of combing wool? A Yorkshireman, who came out here last year, says that Preller's is reputed the best, but what it is he cannot exactly tell. Can you favour us with any information on the subject?—*One of many Readers.* Adelaide, May 13, 1847." Preller's machinery (imported from abroad) was patented in England, January 7, 1843; about a dozen sets of it are in full operation at Bradford, which it is well known is the chief sect of English wool-combing, and the use of it in this country is extending. On referring to the specification of this machinery we find that its principal recommendations consist in its being equally applicable to the finest and shortest wool, and in no heat or oil being required during the process; of which last peculiarity a consequence is, that the yarn spun from the wool remains as clean and white as washing with soap may have previously rendered it. The wool, after being carded, is wound tightly on bobbins,

and kept on them for several days, by which the fibres are straightened preparatory to their being transferred to the combing machine. Another system of combing has been more recently introduced from Germany by Mr. Simson, the Consul for Baden, a full account of which is given in the *Mech. Mag.* for Feb. 27, 1847.

Electricity developed by Caoutchouc Cloth.—" On tearing up an old Mackintosh cloak the other day, it exhibited a train of brilliant electric sparks. Has this property of caoutchouc fabrics been observed before?—*P. N.*" We do not recollect to have seen this fact noticed before; but the same thing happens, as every one knows, on the tearing up of old and dry textile fabrics of any description; the addition of the caoutchouc may very likely add to the effect, for caoutchouc holds a high place among the non-conductors, and non-conduction is the cause of the display produced by the rending asunder of such fabrics.

Ship Fender.—We do not think there is the least chance of so cumbrous an apparatus, for the protection of vessels from stranding, &c., as "A Young Mechanic" proposes being adopted, and cannot advise him to expend either his own "tin," or anybody else's in testing its efficiency. The propeller of the same correspondent is not new.

Drain Tile Machines.—" The specifications of the tile machines which have been patented during the last seven years" have not been collected anywhere; "G. R." must search the Record-offices or scientific journals.

How far an Inventor may avail himself of Assistance.—" I lately conceived what I consider a great improvement in a branch of our machinery, and set one of our workmen to work out the idea. The man now insists on being considered as himself the inventor, and I am deterred from applying for a patent as I had intended. How does the law stand as to this?—*P. H.* Hull, December 29, 1847." It has long been settled law that a master is entitled in such a case as that mentioned not only to the assistance of his own workmen, but to call in the aid of perfect strangers, and that his right to a patent is not thereby in the least affected.

Cambridge Mathematics.—We have received a reply from " + " to the remarks in our last by the reviewer of Potts' Euclid. He states that in returning to the subject he but obeys the call made upon him by the reviewer. We admit this to be true; but as we must have regard at the same time to the useful occupation of our pages, and do not for ourselves see that any good could result from the prolongation of the discussion, (which would not certainly end with " +'s" letter were it to be inserted) we must beg that he will consider the call as re-called. It may suffice for the perfect vindication of the part which he has so far taken in the discussion to give the introductory paragraph to his present communication:—" The principal motive which urged me to address you upon a former occasion was a desire to limit the assertions contained in various articles lately published in your Magazine, and appearing to me rather unsuitable to the pages of a journal so long devoted to the advancement of *practical* philosophy. Finding that similar opinions were held by other friends, and well-wishers of your valuable periodical, and becoming convinced that the language of the articles alluded to savoured more of (I might almost prefix the word 'personal') prejudice than was becoming, I ventured to submit for insertion such a protest as might indicate that at least your readers were not *unanimous* in their approval of the opinions so advanced."

NOTES AND NOTICES.

New Wine Press.—The *Brevet D'Invention* states that a wine press, of very simple construction and great power, has been recently invented by M. Koeppelin, Secretary to the Agricultural Society of Colmar. It consists of a metallic vessel, the diameter of which is equal to twice its depth, and which is divided in the middle by a moveable diaphragm of any impermeable fabric. The space above the diaphragm is filled with grapes, and then a perforated cover put on, which is made fast to the top of the vessel. Water is next forced in beneath the diaphragm by means of a pump, and, by its irresistible pressure, expresses the juice, and causes it to flow through the holes in the cover. Numerous experiments have been made with this machine before the Congress of Vine-growers, the Agricultural Society of the Haut-Rhin, and the Industrial Society of Mulhausen. It is stated to work with great facility and rapidity, to occupy little space, and to be easily moved about. The same machine may, no doubt, be employed with advantage for the expression of juice from apples, beetroot, olives, &c.

New Ink—New Test for Ozone.—Professor Schonbein, in a letter to Professor Faraday, says—" You are no doubt struck with the peculiarity of the ink in which this letter is written, and I am afraid you will think it a very bad production; but, in spite of its queer colour, you will like it when I tell you what it is, and when I assure you that as long as the art of writing has been practised, no letter has ever been written with such an ink. These lines are written with a solution of sulphate of manganese. The writing being dry, the paper is suspended within a large bottle, the air of which is strongly ozonized by means of phosphorus. After a few minutes the writing becomes visible, and the longer you leave it exposed to the action of ozone, the darker it will become. Sulphurous acid gas uniting readily with the peroxide of manganese to form a colourless sulphate, the writing will instantly disappear, when placed within air containing some of that acid; and it is a matter of course that the writing will come out again when exposed to ozonized air. Now all this is certainly mere playing; but the matter is interesting in a scientific point of view, inasmuch as dry strips of white filtering paper drenched with a weak solution of sulphate of manganese, furnish us with rather a delicate and specific test for ozone, by means of which we may easily prove the identity of chemical, voltaic, and electrical ozone, and establish with facility and certainty the continual presence of ozone in the open air. I have turned brown my test-paper within the electrical brush, the ozonized oxygen obtained from electrolysed water and the atmospheric air ozonized by phosphorus. The quantity of ozone produced by the electrical brush being so very small, it requires of course some time to turn the test-paper brown."

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Bell, of the city of Dublin, merchant, for certain improvements in the arrangement of wheels and axles for steam and other carriages, which facilitate travelling on railways and common roads, parts of which improvements are applicable to other machinery. January 7; six months.

James Montgomery, of Salisbury-street, Middlesex, for certain improvements in pianofortes and other similar finger-keyed instruments. (Being a communication.) January 11; six months.

Alfred Augustus de Reginald Hely, of No. 11, Cannon-row, Westminster, and Joseph Emmett Norton, of Saint Mary-le-Strand-place, Kent-road, Surrey, wine-merchant, for certain improvements in bottles or vessels for containing liquids, and in the mode of and machinery or apparatus for filling and stopping the same. January 11; six months.

Gardner Stow, late of King-street, Cheapside, but now of New York, gentleman, for improvements in apparatus for propelling ships and other vessels. January 11; six months.

William Thorold, of Norwich, engineer, for improvements in turn-tables. January 13; six months.

Robert Wilson, M.A., Greenock, for improvements in certain kinds of rotatory engines worked by steam or other elastic fluids, part of which improvements are applicable to rotatory engines worked by water, or by the wind; also, an improvement in safety-valves for steam boilers. January 13; six months.

Sydney Edwards Morse, of Ampton-place, Gray's-inn-road, for improvements in the manufacture of plates or surfaces for printing or embossing. January 13; six months.

Benjamin Mitchell, of Huntingdonshire, farmer, for improvements in the manufacture of manure. January 13; six months.

Robert Heath, of Heathfield, Manchester, gentleman, for certain improvements in the method of applying and working friction brasses to engines and carriages used upon railways. January 13; six months.

Job Cutler, of Spark Brook, Birmingham, civil engineer, for certain improvements in welded iron pipes or tubes to be used as the flues of steam boilers. January 13; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Jan. 7	1313	Marc Louis Adam Tarin	Knightsbridge	The upper part of a lamp.
,,	1314	Alexander Haig	Stepney	The "Unum Pollum" fan-blast, or blower.
,,	1315	Francis Bassand	Birmingham	Roof-lamp for railway-carriages.
9	1316	Etienne Isaac de Lara,	Little Alie-street, London	Pocket umbrella or parasol.
10	1317	John Paterson	Wood-street, Cheapside	Trouser-brace regulator.
,,	1318	Martha Norton	Strand	Ladies' equestrian skirt.
11	1319	Thomas Mills	Birmingham	Expanding and contracting table.

Advertisements.

Gutta Percha Company, Patentees,

Wharf-road, City-road, London.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in Bands of an indefinite length, render them superior for almost all working purposes, and decidedly economical.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Haslingden, September 4, 1847.

Dear Sir,—We have now been using the Gutta Percha Straps for the last eight months, and have great pleasure in saying they have answered our most sanguine expectations; and we may add, that some of our machines which required a 12-inch leather strap, and which almost daily required to be repaired, we have been turning the same with the Gutta Percha Straps 10 inches only for the above-named period, and now find them as good as the day they were first applied.

We remain, yours respectfully,
W. & R. TURNER.

To S. Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

Sir,—In reply to your inquiry as to the result of our experience with the Gutta Percha Straps, we have great pleasure in stating that the advantages they possess are so very manifest as to induce us to apply them in almost every instance where new straps are required.—We are, Sir, very respectfully,
SHARP, BROTHERS.

Samuel Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

Sir,—In reply to your inquiry respecting how we like your Gutta Percha Machine Straps or Driving Belts, although we have not had quite so much experience in the above-named use of Gutta Percha as we hope to have, so far as we have employed it, it has given us general satisfaction. The beautifully straight and regular manner in which it runs on the pulleys, especially on our cone or speed pulleys, is a strong recommendation in its favour; and although we are inclined to think it does not take so fast a grip on the pulley as leather, yet there is ample hold for all general purposes. We shall continue to use it and to give it our best attention, so as to learn how to employ to best advantage the many excellent qualities it possesses over the ordinary leather belts.

NASMYTH, GASKELL, & CO.

S. Statham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

Dear Sir,—We beg to inform you that we have now had the patent Gutta Percha Bands or Straps in use for more than six months. For tube frames we consider them very much superior to anything we have tried before. They also do very well as open straps for mules, throstles, looms, &c.

We are, Sir, yours respectfully,
THOS. DODGSHON & NEPHEWS.

Mr. Samuel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

Gentlemen,—We have much pleasure in bearing our testimony to the valuable qualities of the Gutta Percha for driving bands. We have found it answer exceedingly well in most cases where we have tried it, and we think it has only to be made known to ensure its very general use.

We are, Gentlemen, yours obediently,
HOLE, LINGARD, & CRUTTENDEN.

To the Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

Dear Sir,—Your letter of the 31st August is to hand, and in answer respecting the use of your Gutta Percha Bands, I cannot give you a better

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1276.] SATURDAY, JANUARY 22, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166 Fleet-street.

JOWETT'S PATENT WATER TELEGRAPH.

Fig. 1.

No. 1. No. 2. No. 3.

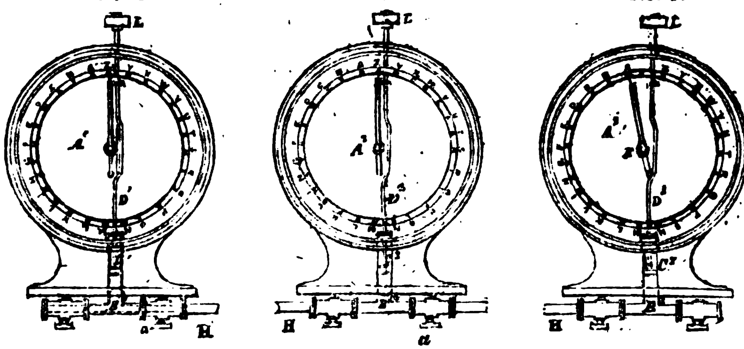


Fig. 2.

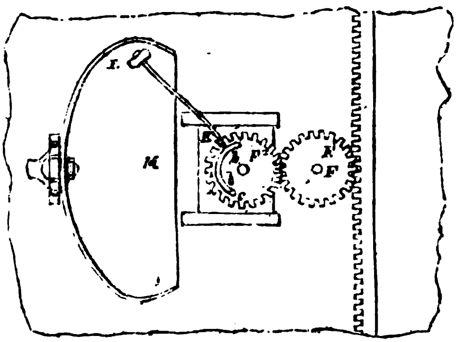
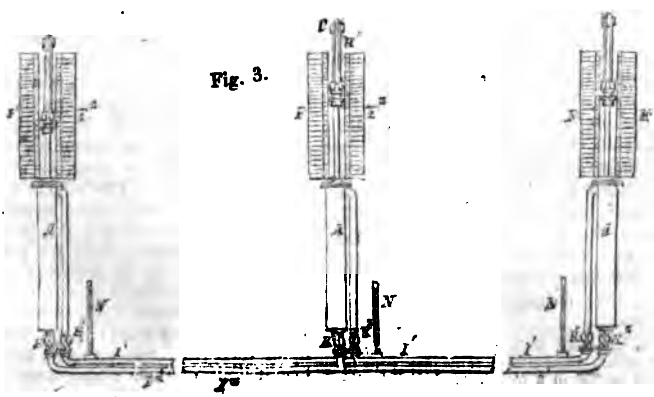


Fig. 3.



JOWETT'S PATENT WATER TELEGRAPH.

[Patent dated January 23, 1847. Specification enrolled July 23, 1847.]

While the public are so occupied, as at present, with the wonderful performances of the electric telegraph, and with the vast change in all our social relations, which seems very surely destined to follow in its train, it is hardly to be expected that it should give a ready ear to any scheme of telegraphic correspondence of avowedly humbler pretensions. Yet it would not perhaps be unwise in the said "public" were they to be somewhat less exclusive in their devotion—less transcendental in their anticipations. However desirable it may be, to have the power of communicating in an instant, with the remotest corners of the kingdom, it may not be equally so for all purposes and under all circumstances. As our horses need not all be racers, so neither may it be needful to have all our telegraphs working at the rate of a thousand characters a minute.* Extraordinary speed may in the machine, as well as in the animal, cost more than the thing is in a majority of cases worth; and it may therefore be a matter very fit for inquiry whether a lesser degree of speed cannot be obtained at so cheap a rate (if not by the aid of electricity by some other agency) as to come within the scope of the wants and means of every one. We put here in a hypothetical way what Mr. Jowett, with the enthusiastic confidence common to inventors, insists upon as being a matter of no doubt at all. He presents his plan of a water telegraph to the public, as costing a great deal less, not only to fit up, maintain, and work, than the electric telegraph, but offering as high a degree of speed as most persons will care to accomplish. Indeed, he can hardly be said to admit the velocity of the electric current, to be at all superior to that with which his column of water can be actuated from end to end. For though we have inferred as much from the fact of his putting the "economy" of his plan in the foreground of his picture of its advantages, we cannot in truth fix him with any such admission in express terms. He has proved experimentally, at Derby, that a message may be conveyed by his water telegraph, for a distance of about two miles, in an almost unappreciable space of time; and he concludes from this, that making every required allowance for friction, it cannot make a difference of more than a minute or so whether the distance is two miles, or two hundred, or two thousand. For our own parts we should say that if the distance to which intelligence can be conveyed by this water telegraph in "the unappreciable space of time" can be but extended to ten or a dozen miles, it will not only prove a powerful rival to the electric, but may perchance even exceed it in general usefulness.

In figs. 1 and 2 of the accompanying engravings an exemplification is given of the application of this telegraph to the communicating of intelligence between any two of three different stations, from which the manner of applying it to any number of stations whatever may be readily deduced.

No. 1, No. 2, and No. 3, are the three stations; A^1, A^2, and A^3, are three dial plates, upon each of which are marked in two concentric circles two sets of the various letters of the alphabet, or of any other agreed-upon system of signs or symbols, but in an inverse order; that is to say, for example, if the letters A to Z in the larger circle read from right to left, then the same letters in the smaller circle must read from left to right, or *vice versâ*. B^1, B^2, B^3, are small metal cylinders placed at the back of the plates, A^1, A^2, and A^3, within which there are accurately fitted the pistons, C^1, C^2, and C^3, the rods of which D^1, D^2, D^3, have each at top a fine toothed rack cut upon one side, which gears into a small pinion, E, fixed to the spindle, F, to which an index-hand, G, is affixed; L, L, L, are balance weights. H is a pipe which connects the three cylinders, B^1, B^2, and B^3, together, and may be carried in any direction required, as horizontal, oblique, or vertical, or under, or over, or around any obstructing object. This pipe is to be filled with water or any other suitable fluid. The first of the cylinders, B^1, is filled with the fluid employed, until its piston, C^1, when resting upon the surface of the fluid, stands at the greatest limit of its range in an upward direction. The other cylinders, B^2, B^3, are only filled till the fluid presses upon their respective pistons, when at the lowest limit of their range. The mode of operation is as follows: Supposing that it is

* This is what Mr. Bain proposes to do, and which his private experiments fully justify us in anticipating he will in a month or two actually accomplish.

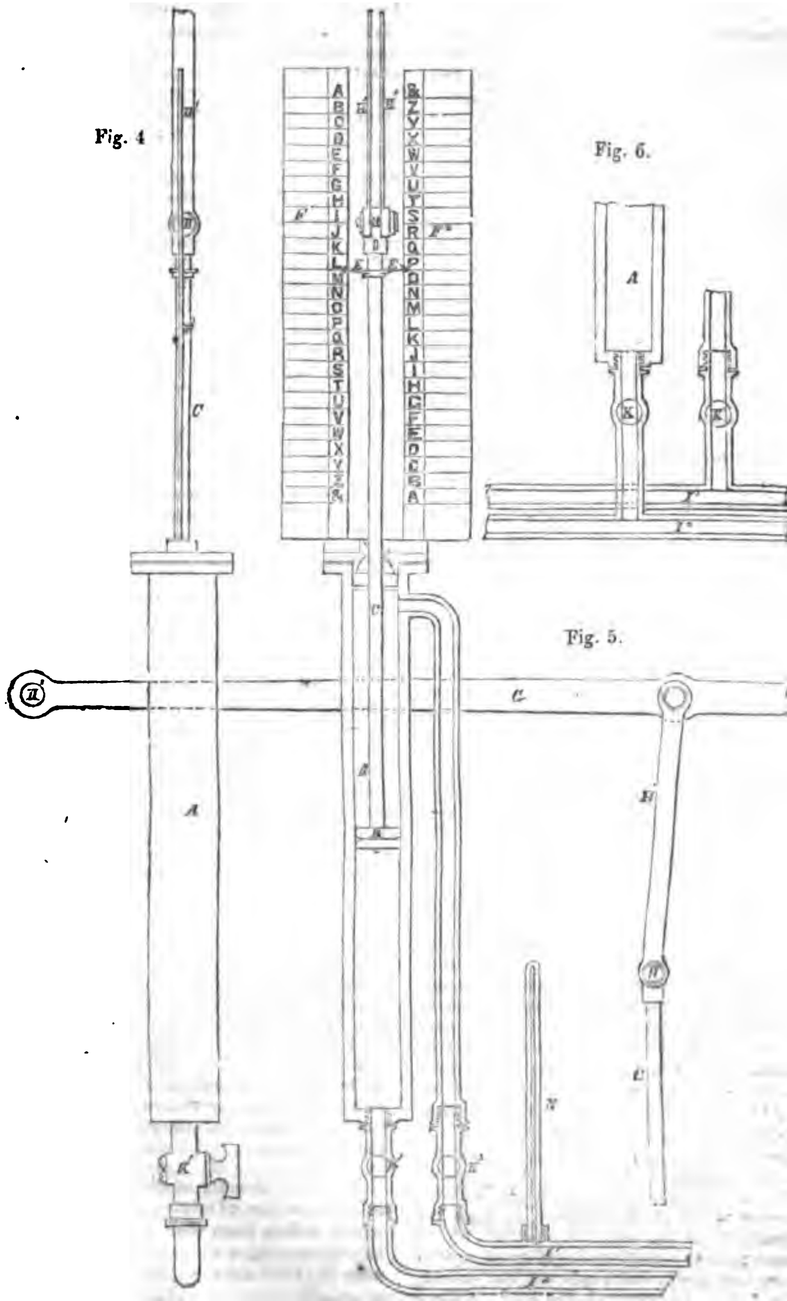


Fig. 4

Fig. 5.

Fig. 6.

wished to convey intelligence from the station No. 1 to the station No. 3, the communicator of the message at No. 1 first calls the attention of the attendants upon the two other instruments by depressing the piston, C^1, which pressing upon the surface of the fluid contained in the pipe, H, causes the fluid to rise immediately in the other two cylinders of the line, and consequently to produce corresponding movements of the pistons in the different cylinders, which movements again cause each a bell to ring, by means of the arrangements which are represented separately in fig. 2. A, is the back of the dial-plate; F, the index-hand spindle; and E the pinion, before described, as being fixed upon that spindle. E^2 is a second pinion, the axis of which is fixed into a sliding-piece, K, so that this pinion, E^2, may be allowed to slide forward until it comes into gear with the pinion, E, or be removed therefrom at pleasure. *b b* is a slot in the pinion, E^2, through which there is passed a stop-pin, *c*, which terminates in, and is fixed into the sliding piece, K, whereby the extent of the revolution of the pinions, E and E^2, and the range of the movement of the piston, are determined.

For the sake of further illustrating the manner in which this part of the invention is performed, let it be supposed that there are twelve stations instead of three upon the line of telegraphic communication; and further, that all the pistons, C, of the instruments, excepting that of the instrument placed at No. 1 station, are at the bottom of their respective cylinders; and further, that the pinion, E, and E^2, are put into gear with each other. If, then, the person in attendance at No. 1 station should now wish to communicate with No. 7, he depresses the piston of this apparatus, which is the only one of the whole set which, as before stated, is at the top of its cylinder, and causes it to descend through 11 inches, which makes the pistons of all the other eleven to rise just 1 inch each, which distance is the exact limit allowed to them to move by the stop-pin, *c*. But the turning of the pinion, E^2, causes the hammer, L, which is attached to it, to come in contact with the bell, M, and thereby to give warning to the whole of the other eleven stations. Now, by again raising up the piston at No. 1 station to the top of its cylinder, another stroke is produced at all the other stations by the depression of the pistons and the reverse action of the hammer, L, upon the other side of the bell. A repetition of the same process is continued until seven strokes have been given, which indicates that station, No. 7, is to be communicated with. When a communication is desired to be transmitted from any of the other stations, excepting No. 1, then the attendant at that station first slides back the piece, K, which admits of his raising the cylinder piston to its highest point, which again causes the piston of No. 1 station to descend to the bottom of the cylinder and give warning there by the ringing of the bell (it being the only one in the whole set which is capable of being acted upon, as all the others are at the bottom of their respective cylinders). The attendant at No. 1 station now puts the pinions, E, and E^2, of his instrument into gear, upon which the instrument, at the station from which it is desired to transmit intelligence, will be in the same position as has just been described in reference to station, No. 1, previous to commencing intercourse with the station, No. 7. The attendants being thus apprised of each other's readiness, the communication of intelligence is proceeded with in the following manner: The pistons of all the other instruments, excepting those of the two stations, between which the communication is to be transmitted, are pressed down to their lowest position in their respective cylinders, and kept in that situation by means of a catch which is fixed to the back of the dial-plate. The person transmitting the intelligence now brings the index-hand successively to such of the letters, or signs, on the dial plate before him as are requisite to express the message or intelligence desired to be transmitted (this he accomplishes by means of a crank handle, which is slipped upon the end of the spindle, F). Whatever may be the letter, or sign, to which he thus brings the index hand on the inner circle of his dial plate, the index hand of the recipient instrument will point to the same letter, or sign, upon the outer circle of letters, or signs, upon the dial plate of that instrument. By referring to fig. 1, it will be seen that the index hand of No. 1 is at A, upon the inner circle, and that of No. 3 at A, upon the outer circle. Should the communication be between any two contiguous stations, such as No. 2 and No. 3, then the stop-cocks, *a a*, may be used to shut off all communication with the other stations. The index hand may be made after the manner of a telescope, so as to be lengthened or shortened at pleasure, and thus applied to either of the circles or the dial plates.

Fig. 3 represents an elevation of part of another line of telegraphic apparatus, which differs from that just described in having two lines of pipe instead of one, whereby the fluid contained in the one line of pipe is made to act above the pistons in the cylinders at the different stations;

and the fluid which is contained in the other line is made to act below those pistons. The index is also put in a line parallel with the piston rod of the different cylinders, which greatly simplifies the apparatus.

Fig. 4 is an elevation of a single apparatus, on the plan of that last mentioned, adapted to the end of a line of telegraphic communication.

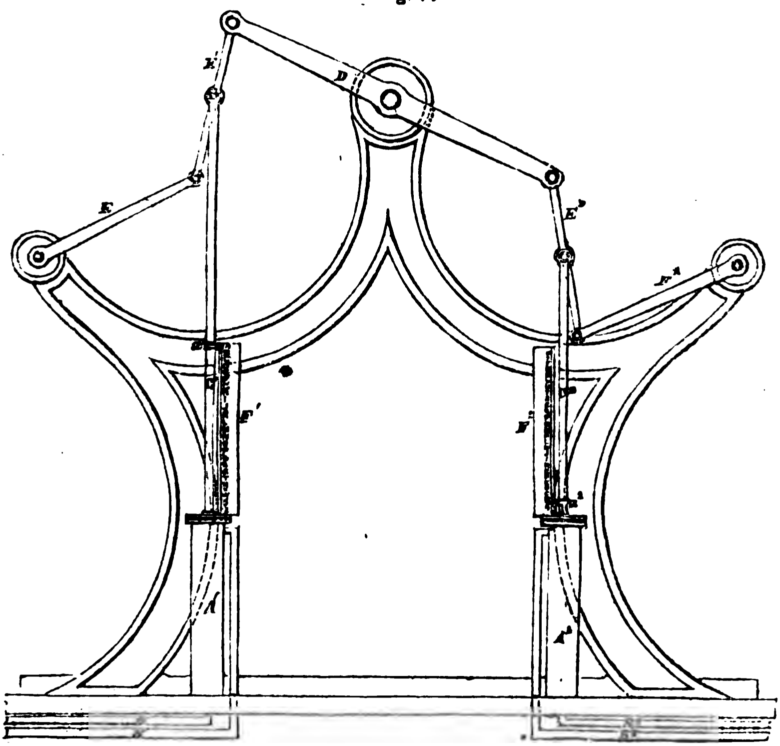
A, is the cylinder; B, the piston; C, the piston rod; D, a stuffing box, to prevent the escape of water; E, the index hand; F^1F^2, index plates; G, (fig. 5,) a lever handle, by which the attendant raises or presses down the piston to the desired spot; this handle is joined at H to the piston rod, C, by two connecting links, H^1H^1; and at H^2 it is jointed to some fixed point as a fulcrum. I^1I^2, are the two water pipes, the one entering at the bottom of the cylinder, the other at the top. K^1K^2, are stop cocks.

Fig. 6 shows the way in which an apparatus at an intermediate station may be attached to the pipes I^1I^2.

The manner of calling the attention of the attendants on the different instruments in the first instance, may be accomplished by an adaptation of the machinery and bell, which have been already described as applied for this purpose to the telegraphic apparatus represented in figs. 1 and 2. The station attendants being apprised of the intention to communicate intelligence, must all (excepting the two between which the communication is to be maintained) shut the stop cocks, K^1 K^2. Then every motion of the piston that is made by the communicator at the one station will be followed by a corresponding movement of the piston at the other or recipient station, so that, whatever letter the index hand may be brought opposite to upon the right hand index of the one instrument, will be pointed to by the index hand upon the left hand index of the other instrument.

As it is necessary that the attendants at those stations which are not actually engaged in transmitting or receiving the intel-

Fig. 7.



ligence should know when the communication which has been going on has been completed, so that they may not put their apparatus again in connection with the pipes, I^1 and I^2, before that is done, and so derange the proper action of the recipient instrument, there is fixed at the side of one of the pipes, I^1, a small, upright glass tube, N, which is open at its lower end to the tube upon which it is fixed, but closed at top. The water contained in the pipe, I^1, rises a short distance within the glass tube, N, at every movement of the water in the tubes, I^1I^2, which necessarily takes place in bringing the pistons to the various letters or signs upon the index, and thus produces a pulsation or rise of the surface of the water in the glass tube, occasioned by a slight compression of the air in the upper portion of it. When this ceases, then the attendants at the various stations know that they may open the communication between the water pipes, I^1I^2, and their respective apparatus, and so be in readiness for any renewed call upon their use.

Another arrangement of apparatus to be used at intermediate stations of a line of telegraphic communication such as that last hereinbefore described, is represented in fig. 7.

A^1A^2, are a pair of cylinders similar to those represented and described in reference to fig. 4; B^1B^1 and B^2B^2, are pipes containing the fluid, through the agency of which the transmission of intelligence is maintained, of which pipes those marked B^1B^1 connect the cylinder, A^1, of this apparatus with the apparatus at the next station, which may be situated at the left hand side; and those marked B^2B^2 connect the cylinder, A^2, with the apparatus, which is similarly placed on the right of it. C^1C^2 are the piston rods, which are connected to an oscillating beam or lever, D, by the parallel movements, E^1E^1 and E^2E^2. F^1F^2, are index plates, the letters or symbols on the one being in the inverse order to those on the other. Whatever motion may be communicated to the piston in the cylinder, A^1, by the action of the fluid contained in the line of pipe, B^1, with which it is immediately connected, it will be transmitted, through the intervention of the piston rod, C^1, the beam, D, and parallel motions, E^1E^2, to the piston rod, C^2, which will then in its turn press upon the fluid contained in the line of pipe, B^2; the movement of which last fluid will actuate the apparatus at the next station in the order of communication, and so on through any number of stations or apparatus, the signals being conveyed as it were by a succession of steps or bounds from the one end of the line to the other. Any one of the two index plates represented in fig. 6 may be used, as whatever letter is pointed to upon the one by the index hand, a^1, will be marked out by the other index hand, a^2, upon the opposite plate. It is, however, proper that both should be retained upon the instrument, because if it should be found desirable to intercept the subject-matter of a communication at any particular point, and prevent it from being transmitted further in any one direction; all that would then be necessary to be done, would be to disconnect one of the piston rods, C^1 or C^2, from the link of the parallel motion to which it is attached.

INTELLECTUAL PROPERTY.—RADICAL REFORM OF THE BELGIAN PATENT LAWS.*

A question is now agitating in Belgium, which, from its nature, is doubly interesting to our own country: firstly, from the position and legal protection with which it is sought to guarantee the rights of intellectual property; secondly, from the endeavours made by a rival manufacturing nation to attract amongst them, by a more favourable system of patent laws, the inventors of all countries, and thereby induce them to identify their interests with its own—a nation which possesses nearly as great natural resources as ourselves, (some even in a more eminent degree) such as cheap and easy transit, abundance of coal and iron, and which already successfully competes with us in some of our staple manufactures.

The rights of intellectual property, though, generally speaking, placed on a better footing in England than elsewhere, are still not so well understood and appreciated amongst us as to be efficiently protected in all their relations. While the law—sometimes facetiously called the "perfection of human reason"—shows no want of care or anxiety to vindicate the position of other descriptions of property, and to hedge in its rights with all imaginable precautions and defences, it awards to no sort of intellectual property more than a very limited degree of protection, and makes distinctions in this respect between one kind of intellectual property and another, which have no foundation but in mere prejudice and caprice. And yet the right and title of every man to the fruits of his mental labour—to whatever purpose of useful-

* *Exposition De L'Industrie Belge. Par J. B. A. M. Jobard, Chevalier de la Legion d'Honneur. directeur du Musée de L'Industrie.* Brussels. 1847

ness that labour may be applied—are no less valid and undoubted, than those which he possesses to the produce of his physical toil.

The possessor of a landed estate, his heirs and successors, are secured by rigorous laws in the undisturbed and perpetual enjoyment thereof. But the possessor of an idea which may be pregnant with results calculated to double the value of all the landed property in the country, is left without any protection for it whatever; unless, indeed, he choose to purchase from Government, at a high price, the privilege of *enjoying his own* for a few short years.

A person who devotes any portion of his time to the production of a literary work, can with us secure the copyright of it to himself and his family for forty-four years certain, on payment of five shillings; but another person who devotes an equal portion of time, and very possibly a much higher degree of talent, to inventing and perfecting a useful machine, can only secure to himself a legal right to it for fourteen years at an expense of £450 and upwards. How can such anomalies be possibly justified?

The literary and scientific men of France have unanimously pronounced themselves in favour of the cause of equal intellectual rights. "A noble cause," writes Victor Cousin, "is that of the vindication of inventive, artistic, and literary property, which appears to me infinitely more rational and respectable than territorial property of any description. In most cases the latter comes by descent or chance, while the former is strictly personal. Artists, authors, and manufacturers come in the order of civilization after warriors, in the same way as despotism precedes liberty."

It is, however, in Belgium that this question has taken the most practical form, and met with the most decided encouragement. We believe that this is due in a great measure to the able and energetic agitation of Monsieur Jobard, whose labours for the last quarter of a century to increase and develop the manufactures of Belgium, and to advance the interests of inventors of all countries, have gained for him not only the universal esteem of his fellow countrymen, but almost an European reputation. In the course of last year, the Belgian Government requested him to draw up a bill ("*projet de loi*") for the reform of the Belgian patent laws; and to answer a series of questions proposed by the Minister of the Interior in relation to them. And having done so, M. Jobard was authorized by an official order of June 24th, 1847, to publish his draft of the bill prior to its being submitted to the Chambers. With a copy of this document we have been obligingly favoured by the author, and we now propose to lay some account of it before our readers. The Bill proposes to establish three classes of patents:—1. Patents for inventions. 2. For improvements: and 3. For imported inventions or improvements. The privileges and conditions attached to each are as follow:

1. In the case of patents for inventions and improvements, the inventor, whether Belgian or foreign, is entitled to the property of his invention during the term of 99 years, on the conditions hereafter named.

2. The patentee is to have the monopoly of manufacturing during 99 years, and of selling during 15 years, the patented articles; and, consequently, is to be entitled to seize, in workshops, shops, and public places, any articles not manufactured by him, having his trade-mark, which infringe his patent; but not the right to seize such articles when employed for the private use of individuals who are not manufacturers.

3. The inventor, who has obtained a foreign patent for an invention or improvement, or his licensee, shall alone be permitted to obtain a patent for the same subject, in Belgium, during the twelve months following.

4. The patentee to be allowed to take as many certificates of improvements in and additions to his invention as he may desire, on payment of 10 francs for each certificate.

5. The patentee or his licensee to be alone permitted to deposit memoranda of improvements, or additions to his original invention, during the two years following the date of the original patent.

6. Mere ornaments, change of form or of scale, change or displacement of parts, are not considered inventions, unless fresh results are thereby produced.

* * * *

8. Every application for a patent is to be published in a special gazette, at the expense of the applicant; the cost not to be less than 25 francs per page of letter-press, nor more than 50 francs for each quarto size engraving. Each patentee is to be furnished with 50 copies of his description; one

of which, when signed and sealed by the MINISTER of the INTERIOR, to serve instead of the official document (letters patent). This gazette, published under the direction of the minister of the interior, is to appear periodically, and be distributed to the governors and commissioners of districts and chambers of commerce; also to the burgomasters of the principal provincial towns, where it may be referred to by all concerned.

9. Workmen or poor inventors are to be exempt from the expenses of publication.

10. During four months after publication, oppositions can be entered to the issuing of a patent. Oppositions founded on the fact of the opponent being in possession of the working of the method for which a patent is applied for, are alone to be received. The minister of the interior to judge of the validity of the opposition, and to have the power of referring the decision, if deemed necessary, to the law courts for legalization. The patent not to be issued until four months at the soonest, and six months at the latest, after the publication of the application; or, as the case may be, after the withdrawal of opposition.

11. The patent, when granted after the fulfilment of the formalities before described, not to be impeachable at law: nevertheless, any individual who can prove that he manufactured the patented article before the entry of the first caveat, is to be allowed to continue the free working of the same.

12. The patentee to be obliged to stamp or mark his name, followed by the word *patented* on the patented article when such proceeding is possible; or, when the article is such as to render the stamping or marking impossible, to ticket the same.

13. The patentee to be obliged to work his patent, in Belgium, within twelve months from its being worked abroad, unless sufficient reasons for not doing so are submitted to the minister.

14. In respect to patents of importation; any art or manufacture known, described, and exercised abroad, whether new or old, but which is not worked in Belgium, can be protected by a *patent of importation*. Each applicant for a patent of importation to lodge, with his application, a list of the articles or products, and, if possible, specimens or plans thereof, the manufacture of which he undertakes to introduce into the country within a certain time. If the minister deems the application worthy of being received, it is to be published in the same form as the patents of invention, and during the same time. The length of time for which the patent is applied for, as well as the principal conditions thereof, are also to be published.

15. The patent of importation gives only the monopoly of manufacturing the patented articles in Belgium; but not the right of preventing the sale of similar articles manufactured and imported from abroad.

16. Every patentee of an imported invention to be obliged to put his trade mark upon the manufactured article.

17. Any new machine, method, receipt, or proceeding, and all combinations of known elements or means, producing new effects, or new industrial results, are capable of being patented.

18. Chemical compositions, receipts, methods or inventions which may be used without detection by the patentee, and who is, from their very nature, unable to prove any infringement thereof and to ascertain the amount of his loss, are to remain a secret, that is, without official publication, during fifteen years.

19. No action for infringement can be brought until after the patentee has given official notice to the party so offending of his patent right, and then only for infringement after such notice.

20. An inventor, if anxious to secure the priority of his invention, can do so by depositing with the proper authorities, under the name of *caveat*, an outline specification of his invention. This deposit, sealed, and having the name and address of the depositor thereon, together with a descriptive title of the invention, is to remain under cover for six months. Several caveats may be successively entered according to the progress of the invention, on payment of five francs for each caveat; the date of the caveat to establish the priority of the invention.

21. The patentee to pay a Government tax, which is to commence with ten francs for the first year and be increased by ten francs each successive year, and further be augmented every five years by ten francs additional, until it amounts to 10,350 francs for the 99th, or last year of the patent.

22. The sale or assignment of a part or whole of a patent, and the licenses to manufacture the patented articles, are to be communicated to the ministry by a statement, signed by the two contracting parties, and published in the official gazette of inventions.

23. The proprietor of a patent may be obliged to surrender his patent right on plea of utility, safety, or public benefit, on payment of a just indemnity, which is to be paid in advance, and fixed by the patentee and government, or, in case of dispute, by the law courts, which may appoint

persons for the purpose of estimating the value of the patent right.

24. No patent to be declared void except for the following reasons:

(*a.*) If the applicant fraudulently omits, in the specification, any important point, so that a workman would not be able to manufacture from the description the patented article, receipt or product.

(*b.*) If the invention is proved to be a violation of the laws of the kingdom.

(*c.*) If the patentee omits to pay the annual tax.

(*d.*) If the patentee, abusing the monopoly conferred upon him, shall be content to import the patented articles, and neglect to manufacture them in Belgium.

(*e.*) If the patentee omits to work his invention within the time allowed.

(*f.*) All patents of improvement or addition, if they have no relation to the original patent; but nevertheless the applicant is to be informed that he is at liberty to change such patent of improvement or addition into one for an invention.

25. An invasion of a patentee's rights, either by making the article or employing the same means, constitutes an infringement.

26. Persons knowingly concealing, selling, advertising, or exposing for sale, articles which infringe a patent right, or are without the patentee's mark, and persons who after due notice shall continue to purchase such articles, are to be fined from 100 to 2,000 francs; without reference to the damages which may be subsequently sought for, and which in no case are to be less than 1,500 francs.

In the case of a repetition of an offence, a punishment of imprisonment of from one to six months is to be inflicted in addition to the fine; but subject to commutation by arrangement with the patentee.

The Bill, of which these are the leading features, having successfully passed through Committee, the Report was brought up and read to the legislative chamber by one of its most distinguished members, M. Lejeune, on the 7th of last month. We extract from the Report of the Committee the following very pertinent and sensible remarks:

"A member of the central section is of opinion that an excellent opportunity now occurs of recommending to the serious attention of the Government the questions which arise from the present state of intellectual property. *Everyone is the responsible proprietor of his own works.* This great principle appears to be generally admitted without dispute, but has remained until now a principle only; for if intellectual property is an incontestible right, it is still without that social guarantee which should preserve it, and without those laws which should regulate its use. This principle awaits its fruitful application from a new legislation: as yet it has penetrated but rarely and timidly into our legal code. The idea of placing intellectual property upon a larger basis has however taken root and developed itself in Belgium; it extends far and wide its branches, and while neighbouring countries hasten to gather the fruits thereof, let us not be the last to secure our share. Without doubt this is one of those measures which will confer honour upon our age, and exercise great influence on humanity. In fact, this principle, properly applied, would serve to influence usefully many brilliant minds, to day idle, or at least barren, and dangerous to society from the fact of their being idle. It would give a right direction to many men of noble hearts and minds, who, crowding into the same path impede and trample down each other. The recognition of it would be of great utility, if no other good resulted, than the clearance which it would effect of the official avenues of Government, by giving another direction and indicating a better future to so many citizens, who now see no other channel of employment except in the public service, however humble or unpretending that position may be. The cultivation of intellectual property is, without contradiction, the most legitimate and most honourable means of acquiring wealth. How is it, then, that this property should be still left without protection, without the right of citizenship, and, in some sort, at the mercy of the first appropriator?

The first thing to be done is to effect a radical reform in the patent laws. Certainly we must not allow ourselves to be dazzled by the prodigious results which the author of the project on this head seems to promise; but these results, which are but a secondary consideration, may nevertheless be such as to produce in the course of time a source of public revenue. And it is this view of the question which induces its recommendation to the special consideration of the Government at the moment of discussing the budget of ways and means. The central section supports these observations, and is of opinion that *the revision of the patent laws* has become indispensable."

In the course of the debate which followed, the Minister of Finance observed in reply:

"M. Lejeune has called the attention of

the chamber to a question which occupies the public and the press: I allude to the revision of the patent laws.—This matter is not within the province of the finance; but knowing that it is the intention of the minister of the interior to examine the important question, which is equally interesting to me because it is a question of revenue, I think I may assure the chamber that it will be submitted to the examination of competent men, with the view of appreciating it according to its importance."

CHAPTERS ON ANALYTICAL GEOMETRY.

BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[Concluded from vol. xlvii., p. 452.]

CHAP. IX.—*Hyperboloids; Unreal Surfaces; Conclusion.*

SECTION 1.—*On Hyperboloids.* In the equation

$$xy+dxz+eyz+fx+gy+hz+i=0,$$

let the coefficients be real and d and e unequal and different from zero; then (vol. xlvii., pp. 547, 451,) this equation can be reduced to the form

$$(x+z_1)(x+z_2)-dez^2+z_3=0,$$

where z_1, z_2 and z_3 are in general all linear functions of z with real constants, although z disappears in particular cases from z_3.

Assume,

$$x+z_1=p+q$$
$$x+z_2=p-q,$$

then $$(x+z_1)(x+z_2)=p^2-q^2;$$

again, we may make

$$-dez^2+z_3=\pm r^2\pm m^2,$$

where r is a linear function of z, and m^2 a number. Hence the given equation may be put under the form

$$p^2-q^2\pm r^2\pm m^2=0,$$

which is equivalent either to

$$-p^2+q^2\pm r^2-m^2=0,$$

or to $$p^2-q^2\pm r^2-m^2=0,$$

and both these latter forms are included in

$$P^2\pm Q^2-R^2-m^2=0.$$

Which represents a hyperboloid of one or two sheets as we take the upper or the lower sign.* This will be seen on referring to the article "Surfaces of the Second Degree" in the *Penny Cyclopædia* (vol. xxiii., p. 303,) or to the third† and eighth‡ of these "Chapters."

* Cones are to be considered as limiting cases of these hyperboloids.

† *Mechanics' Magazine*, vol. xlvi., p. 271.

‡ *Ibid.*, vol. xlvii., p. 451.

In fact, the system of equations

$$P^2-m^2=0,\ Q^2-R^2=0,$$

belongs to the case noticed in the former chapter, and

$$P^2-m^2=0,\ Q^2+R^2=0,$$

to that considered in the latter one. I would add, that in the last case planes whose equations are

$$P^2-m^2-n^2=0\,*$$

meet the surface in curves (ellipses) whose equations are

$$n^2-Q^2-R^2=0.$$

Contrary to my anticipations (vol. xlvi., p. 246, § 5,) we have been enabled to conduct the discussion of the point-surfaces of the second degree without introducing "*unreal* modifications of our former propositions." Instead of unreal lines of intersection we have considered real points of contact.

SECTION 2.—*Unreal Surfaces.* By a rigid interpretation of the radical sign we may often impose material restrictions upon the meaning of algebraic expressions. Thus the equation

$$y=+\sqrt{1-x^2}$$

will, when the positive value of the radical is adhered to, represent a *semi-circle*. To determine the points in which this semi-circle cuts the axis of x we make

$$y=0, \text{ and } \therefore\ 1-x^2=0,$$

hence the curve meets the axis of x in two points distant respectively 1 and -1 from the origin.

Let us next inquire where the curve whose equation is

$$y=+\sqrt{1+x^2}$$

cuts the axis of x. In this case we find that

$$x_1=+\sqrt{-1} \text{ and } x_2=-\sqrt{-1}$$

are the coordinates of the two points where this intersection occurs. These points are *unreal.*

But if we sought to determine the coordinates of the points of intersection of the curve

* These planes are exterior to those whose equations are $P^2-m^2=0$. In Chapter VIII. (vol. xlvii., p. 451,) I should have added

$$u^2-v^2-w^2-n^2=0,$$

as the equation to the point-hyperboloid;

$$u=\pm\sqrt{n^2+m^2},$$

as those of the exterior intersecting planes; and

$$m^2-v^2-w^2=0.$$

as those of the curves (ellipses) of intersection.

$\therefore \quad y = 3x - 5 + \sqrt{30x - 71}$

with the axis of x we should find* that *no such points exist.*

Here, then, we have three distinct cases: (1) real intersection; (2) unreal intersection; (3) no intersection of any kind.

We are now prepared to see that an equation of the third order† may represent a surface, real or unreal, or *no space-entity of any kind.*

It will for instance represent an *unreal* surface when, being of the second degree, it is of the form

$$u^2 + v^2 + w^2 + n^2 = 0;$$

but there are equations, such as

$$1 + \sqrt{x^2 + y^2 + z^2 + 1} = 0$$

which represent nothing whatever.‡ There is a considerable difference between saying that a thing has only an *unreal* existence, and that it has *no existence at all.*

SECTION 3.—*Conclusion.* We are now drawing near the conclusion of these "Chapters." During their progress I have endeavoured to keep practical ends steadily in view. My principal aim was to arrive at easy processes for ascertaining the geometrical interpretation of any given equation of the second degree and third order. In this I hope that I have succeeded. The actual calculations are brief and simple, and the geometrical propositions which I have employed can present so little difficulty to those who have a distinct idea of the surfaces to which they relate, that, except in one or two cases, I have thought it needless to give demonstrations of them. The necessity for a clear geometrical conception of the surfaces will scarcely be considered as an objection to the method, for, without such conception, all the knowledge that can be gained from discussions of the kind is of a purely analytical character.

It would be interesting to compare the methods of Professor de Morgan and Mr. Boole with those contained in some of the preceding papers of this set, and with the reductions which I have given at pp. 504 and 547 of the 47th volume of this work.

The "Architectural Problem" which I proposed in a former volume* is capable of solution by the same method of decomposition into factors as that employed in these "Chapters." This explains my remark at the conclusion of the note† which introduced the "Chapters" to the readers of the present work.

Vineyards, Great Baddow, near Chelmsford, Essex. December 31, 1847.

* *Mechanics' Magazine*, vol. xlvii., p. 151.

† As to the use of this term, see Chapter I., *Mech. Mag.*, vol. xlv., p. 364.

‡ *Mech. Mag.*, vol. xlvii., p. 331.

MATHEMATICAL PERIODICALS.

(Continued from page 57.)

III.—*Miscellanea Mathematica.*

Origin.—This work was begun by Dr. Hutton previously to his appointment as Professor at the Royal Military Academy, in order "to allow room" "for such little essays or dissertations as are too small to print and make a book of." It was continued to thirteen numbers, and was finally completed in a volume of 342 pages, in the year 1775.

Editor.—Dr. Charles Hutton, F.R.S.

Contents.—In the first number is contained the well-known "Dissertation on the times of exhausting vessels," by the learned editor; a lemma, demonstrated by Wildbore; a note, by the editor, and new questions for solution. In the succeeding numbers, solutions of the mathematical questions formed the first article, and the rest consisted of original papers on various interesting subjects, by Wildbore, Dawson, Nauticæ, Wilkin, Hellins, Keech, &c., &c. This work contains the celebrated controversy between Wildbore and Dawson, on the subject of the above-named dissertation.

Questions.—The number of questions proposed and answered is 116, besides several which appear as separate articles.

Contributors.—The principal contributors were—Aspland, Burrow, Coughron, Cole, Crackelt, Dalby, Lawson, North, Wales, Wildbore, and Capt. Edward Williams, of the Royal Artillery, who contributed a series of curious and beautiful general theorems concerning circular loci.

Publication.—The work was published in numbers, which the title-page states were printed for Robinson and Baldwin, Paternoster-row, London.

IV.—*The Student.*

Origin.—This periodical was commenced at Liverpool, in 1797, and was discontinued with the fourth annual number.

* *Mech. Mag.*, vol. xlv., pp. 198-9 and 344.

† *Ibid*, p. 364, first column.

Editor.—Mr. William Hilton, private teacher of the mathematics, Liverpool.

Contents.—The contents of the work were arranged under six heads:—I. Language, Grammar, and Criticism. II. Polite and Useful Arts. III. Natural and Experimental Philosophy. IV. Theoretic and Practical Chemistry. V. Geometry and Mathematical Correspondence. VI. English and French Charades, Rebuses, Enigmas, *Petites Pieces*, &c. The celebrated "Modern Geometry" was begun in this work, and continued up to 62 propositions;—the contributors to this portion being—Non Sibi, Selwen, Butterworth, Wright, Wolfenden, Nicholson, &c. The first number also contains the propositions on "Lineal Sections," (mentioned at page 533, vol. xlv. *Mech. Mag.*)

Questions.—The number of questions proposed and answered is 74, of which the first 18 were proposed, but not answered, in the *British Diary* for 1796. Another set of 18 questions was left unanswered in the last number.

Contributors.—Butterworth, Campbell, Hilton, Knowles, Lowry, Nicholson, Ryley, Smith, Swale, Wolfenden, Wright, &c. Non Sibi furnished the article on "Lineal Sections."

Publication.—It was published annually, for the benefit of the contributors, about the close of each year, and was sold by Vernon and Hood, London.

T. W.

(To be continued.)

AITKEN'S CUPPER'S HORIZONTAL SCARIFICATOR.

[Registered under the Act for the Protection of Articles of Utility. Henry Martin Aitken, of 9, King-street, Manchester, Surgical Instrument-maker, Proprietor.]

Fig. 1.

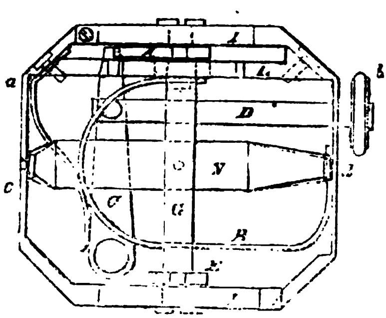


Fig. 2.

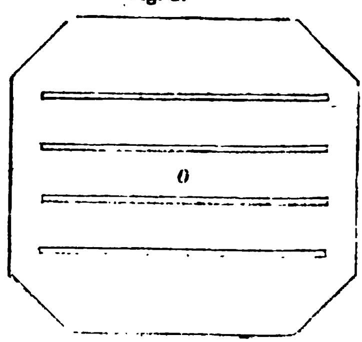


Fig. 3.

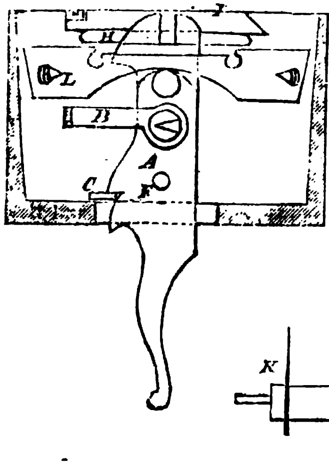
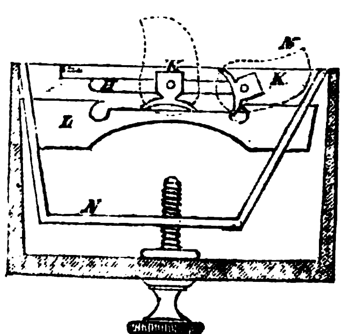


Fig. 4.



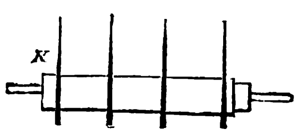


Figure 1, is a plan of this instrument with the top and cutters removed; fig. 2, a plan of the top; and figs. 3 and 4, vertical sections; the former on the line, *a b*, of fig. 1, and the latter on the line, *c d*.

A, is the trigger; B, the main spring; C, a detent which keeps the trigger and cutters, when once drawn back, in the requisite position until the instrument is to be used; D, a pin which is connected to the detent, C, and terminates outside the case in a flat head or button, against which the pressure of the finger is applied to liberate the trigger and cutters. The ends of the cutter-spindle rest at one side in a cleft in the upper end of the trigger, at the other side in a piece of metal, E, which is in every respect similar to the trigger, excepting at the lower end, which does not pass through the case, being cut away below the pin, F, by which it is attached to the case. Whatever movement is given to the trigger, the piece, E, partakes of the same by means of the cross-bar, G. The ends of the cutter-spindle project beyond their bearings in the trigger and the piece, E; and their projecting ends take into parallel slots, H H, formed between the upper edge of the case and the hinged keepers, I I.

By the ingenious arrangement, which has been thus described, the cutters are made always to move in parallel lines, and thereby to make a long incision of one uniform depth.

K, is a tumbler, which is fixed upon the cutter-spindle, and it rests and slides upon the guide, L, so that the cutters during their progress assume an upright position, but at the commencement and end of their progressive movement assume the position indicated by the dotted lines at M. N[2] is a screw-piece, which regulates the height to which the cover, O, may be raised, and thereby determines the depth of the incision.

STRENGTH OF IRON, CHILLED AND UNCHILLED—CASTING OF GIRDERS, CANNON, ETC.

Mr. Editor,—I beg to acknowledge your kindness in the prompt insertion of my papers on the strength of iron, chilled and unchilled.

Some of your readers, when looking at the results exhibited in the case of two of the bars; namely, No. 2 of the first series of experiments, and No. 4 of the second series; may probably ask—In what way, and to what purpose, can the principles on which these bars have been treated be carried into practice?

In reference to the bar, No. 2, first series of experiments, it would be easy to apply the principle to all girders of ordinary construction. In doing so, I would advise a departure from the ordinary mode of casting, or rather, a departure from the position the pattern occupies when under the process of moulding. Girders are generally cast or moulded in one of two modes. One is, to have the web of the girder on a plane with the horizon—the *edges* of the top and bottom flanges being as a matter of course on the same plane. This mode I consider decidedly objectionable, inasmuch as there can be no uniformity in the *density* of the metal of the bottom flange; the under edge of the flange will in every case have an advantage in point of density over the upper edge, equal to the depth of the flange, whereas the upper edge will be in general the receptacle of all the rubbish which is constantly rising to the surface of metal while in a fluid state—thus materially affecting the strength of the most important part of the girder. The other mode of casting girders is to give the top flange the lowest place in the sand, while the bottom flange takes the highest—the web being vertical. This mode I consider still more objectionable than the former, inasmuch as the most important part of the girder, viz., the outer surface of the bottom flange, becomes the receptacle of a large quantity of rubbish, and is generally covered with minute perforations caused by the confined air; it being a fact well known to founders that to obtain a *surface* free from air-holes, and for planing, &c., that the surface must take the lowest place in the mould. In every case girders ought to be cast, with the bottom flange forming the lowest part of the mould. If moulded in that position, the principle on which the bar, No. 2, was treated would be easily adopted. The girder would then be moulded on a train of plates, properly prepared for chilling the outer surface of the bottom flange; in which case the bottom flange would be of uniform density. Besides the increased strength which would result from chilling the two combined, would in my

opinion, add from 15 to 20 per cent. to the strength of girders to resist impact.

In reference to the principle of treatment of bar, No. 4, (second series,) there are a number of articles, which if manufactured on this principle would be greatly increased in value and importance. I shall confine my remarks to two or three only.

The first article which I consider would be materially benefited by the process, is cannon, which would be easily cast in a chill and afterwards annealed. I think I am warranted in saying, that such a process would give at least 50 per cent. increase of strength to resist concussive force.

The cylinders and rams for hydraulic presses would also be easily cast on this principle. These are articles which require very great density and strength to resist the enormous pressure to which they are frequently subjected. Cast on this principle, they would possess a strength and homogeneousness which no other mode of casting can give.

Another article, of much importance, to which the principle would be easily applied, is the metallic packing for the pistons of steam engines. Packing treated in this manner would possess greater *elasticity* and durability than it can possibly possess when cast either from dry or green sand.

I now leave the list of articles, to which these principles could be applied with profit, to be filled up by your numerous and talented readers, and shall be glad if either the experiments or these remarks lead to any useful practical result.

I am, Sir, your obedient servant,

ROBERT BOWMAN.

Highfields Foundry and Wrought Iron-works, Bilston, January 11, 1848.

THE UNION SYPHON—IMPROVEMENTS IN GAS-FITTINGS. BY J. O. N. RUTTER, ESQ.

In arranging gas-fittings it frequently happens that for want of sufficient skill, or it may be of proper care and forethought on the part of the workman, some of the pipes are liable to partial or total obstruction by water collecting in them. If it be partial, it causes a disagreeable flickering of the lights; if total, of course no gas will pass until the water be removed. This is occasioned by the condensation of aqueous vapour, and which is always present in coal gas; the quantity being relatively less or greater, according to the temperature of the atmosphere, and other causes which are so well known as to require no explanation. The vapour is liable to be condensed, or not, according as the pipes which convey the gas are exposed to, or protected from, the influence of sudden changes of temperature.

There is no part of, what may be justly termed, the fixtures of a house in which improvements are so much required as in gas-fittings. The whole business, if rightly understood, is so simple and so easy that one can scarcely imagine it possible to make mistakes; yet I venture to affirm that in no part of domestic economy is there so many blunders committed and so much needless expense incurred; nor is there one which occasions so much vexation, and so many well-founded complaints, as gas-fittings. How easily might this be prevented if gas-fitters would *think* before they begin to work!

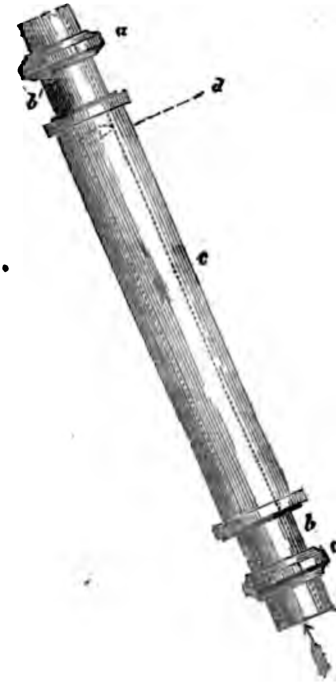
It is sometimes difficult to determine who are most to blame, the masters or the workmen. I believe both are equally culpable. Masters undertake a job without duly considering, and are oftentimes misled by their men, without even knowing what they are going about. To make sure of the work, at all hazards, a price is quoted very much below a fair sum for good materials and workmanship. The order being obtained, men are employed to fix a certain number of feet of tubing to convey gas to the stipulated number of burners; but to keep within the estimated cost the tubing must be as small as possible, and of the commonest description, whilst the labour bestowed must also be curtailed. The work is completed; but the locality of the premises as to distance from gas-mains, or whether on high or low ground, or the probable wants of the consumer, and his periods of burning, are conditions that have never been thought about; or, if ever, so well known, they have never been mentioned. Hence it happens—not once a year, nor once a month, but almost every day—that gas-fittings are scarcely completed and paid for when they are found to be an intolerable nuisance. The tubing is too small, and therefore the supply of gas is insufficient; the joints are badly made,

and there are consequently escapes at all parts of the house; there has been no provision made for draining off the condensed vapour, and so with every recurrence of cold weather, and at the very time that the lights are most needed, they are flickering or going out. To remedy such defects it is by no means unusual that the consumer has to expend in alterations a sum greater than the original cost of the entire fittings.

Wherever gas can be obtained, at a reasonable rate, who is there that does not already use it,—who is not thinking about doing so? Let me forewarn such persons to beware of cheap gas-fittings, and ignorant gas-fitters. I would not have it supposed that relative cheapness is incompatible with good-sized tubing and the best workmanship. What I mean is, that if those men are employed who will undertake work at any price, rather than suffer a neighbour to do it; then, if all go wrong, and nothing but vexation and expense and disappointment be the result, it must not be matter of surprise.

In fitting up a house for gas the principal supply-pipes should be of wrought iron, and of sufficient capacity to convey gas to all the burners at minimum pressure. If it be practicable, the fittings should be so arranged as that it be impossible for any condensed vapour to obstruct the passage of the gas. Occasionally this object cannot be attained; and in such cases a skilful fitter provides a remedy, by placing a stop-cock in a bend of the pipe, so that the water may be drawn off. But if the stop-cock be not opened frequently the plug will set fast, and therefore when its services are required it is of no use.

To provide a ready means of collecting, and of removing, the few drops of water which cause so much trouble and annoyance in gas-fittings, either at unavoidable dips in the tubing, or where the gas passes out of doors, or through a cold part of the house, I suggest the use of what I have named an *Union Syphon.* It is represented below; being simple and cheap in its construction, and can be made to fit tubing of all sizes. In most cases a syphon of this kind will insure free ingress for gas during a whole winter.



a, *a*¹, are unions adapted to the tubing, *b*, *b*¹. *c*, is a piece of tube of a larger size than *b*, in which the latter is inserted and continued to within about half an inch of the upper end of *c*. The syphon must be a little inclined, (as shown in the engraving.) Its operation will be easily understood. The gas passes in the direction of the arrows. The vapour that is condensed in the fittings beyond *b*¹, must be permitted to flow to the syphon. Instead, however, of obstructing the ingress of gas it collects outside the tube, *b*, and is retained in the larger tube, *c*. This will go on until the water rises to the part indicated at *d*: when it will be easy to disconnect the unions, *a*, *a*¹, and discharge the contents of the syphon.

SUSPENSION BRIDGE OVER THE FALLS OF NIAGARA.

(From the *New York Courier*.)

I have been intensely interested to-day in listening to a description, from a well-informed and competent source, of the great bridge over the gorge that separates the dominions of the Queen from those of the President. If anything could be wanting in the attraction of the country about Niagara to turn thither the tour of the multitudes in the pleasure season, this bridge

will supply it. Its thousands of tons weight of the strongest iron cord that the ingenuity of the ironmaster can desire find a safe support in wrought iron anchors built in the solid rock 100 feet below the surface, so that before it could yield, the very rock-bound earth would forsake its tenacity. A large wooden framework is to be placed so that no undulating motion can be experienced. In full sight of the cataract—the surge of angry waters far beneath—the sullen storm-beaten rocks all around—the quick locomotive will put forth all its quickness to rush beyond the peril of its journey. This glorious work is already begun, the money for its cost paid in and available, the excavations commenced, and the contractor is to cross on horseback by the middle of next June. Its firmness is to be such that with all the burden of a powerful locomotive and a long attendant train of cars it is not to vibrate one inch in the centre. The railway is to occupy the centre, two carriageways on either side, and two footways. What a magnificent spectacle this road in full use will present! A road of this kind over the Menai Straits, in Wales, is famous for the daring displayed in its construction. That over the Niagara will soon be world-famed. It will be an iron link of civilization between the two ruling powers of the world, and will never be severed. One of the first thoughts that present themselves in reference to the construction is, as to how the wires are to be thrown across. The steamboat now used below the falls is to take over two cables, to which strands of iron are affixed: these are to be drawn over till two ropes of iron are drawn over, on which a temporary pathway is to be placed—and when I inquired where workmen could be found who had nerve enough to work effectually under such circumstances, the answer so characteristic of American strength of action was, "Oh, there are always plenty of Yankees who have both the courage to work there, and the ingenuity to work well." The great railway in Canada which is to be connected with this mighty work presents some admirable features. Its grade is over 20 feet, and a very, very large proportion of the distance is on a straight line. On one line, perfectly straight, 90 miles are laid out. All the highways of the country are to pass either over or under the road, by depression or elevation, so that there will be neither obstacle nor hindrance to a flight which will put more life into the provincial dominion of Her Britannic Majesty than it has yet seen. "That same" province of Canada West has yet to see great days. England expends millions on sections of her great dominion far less worthy of her notice and fostering care. "The last link" is completed when this great bridge of the cataract shall have been completed. From Boston and New York an unbroken line is presented, and the day is soon coming when some correspondent of yours will delineate the incidents of a 30 hours' journey from the metropolis to Detroit. Such are the movements and the progresses in support of which all may unite, and which mark a busy day!

THE MAGNETIC MERIDIAN.

Sir,—I beg to inform your speculative correspondent, "M. M. F.," who has favoured you with a big circle and a little note attached to it, that his suggestion comes rather late in the day, inasmuch as Professor Barlow—one of the most *useful* of mathematicians—did, in 1823, publish a book, called "An Essay on Magnetic Attractions," wherein there is a theory of his, from which theory he deduced the following relation between the dip of the needle and the *magnetic* latitude (which differs slightly from the geographical latitude):

$$\tan. \delta = 2 \tan \lambda;$$

or, in other words, "the tangent of the dip is equal to double the tangent of the magnetic latitude,"—which, he goes on to say, is "a law which has been obtained by a comparison of magnetical observations in different parts of the earth with each other," *i. e.*, *had been* so obtained *before* his theory thus accounted for it.—(Page 195 of the "Essay.")

I am, Sir, yours, &c.,
H. W. A.

HUNT'S PATENT IMPROVEMENTS IN EFFECTING THE COMBUSTION OF INFLAMMABLE SUBSTANCES.

[Patent dated July 3, 1847. Specification enrolled January 3, 1848. Patentee, John Hunt, of Birmingham, brass-founder.]

The *first* of these improvements consists in the employment of caps, plates, or discs of perforated metal or of wire gauze, which are placed on the top of the chimneys of gas, oil, camphine, or other lamps. The object of this arrangement is to enlarge the flame, and thereby to obtain more light from the consumption of the same quantity of combustible substances.

In explanation of the *second* of his improvements, the patentee observes, that it has hitherto been the custom to make the argand burner and the chimney-holder in several pieces, which are afterwards soldered together; but that he now proposes to cast the outer cylinder of the burner and the rim and bottom of the chimney-holder in one

piece, and the inside cylinder in another piece, and afterwards to solder these two pieces together, as usual; or to cast the inside cylinder, rim, and bottom of the holder in one piece, and then to solder on the outside cylinder; or, instead of casting the cylinders and holder, they may be stamped out.

The patentee states that he is aware that it has already been proposed to suspend, either above or within the chimney, pieces of metal for the purpose of increasing the flame; and that his claims are therefore limited in respect to the first part of his invention to the application of caps, plates, or discs of perforated metal, wire gauze, &c., to the tops of lamp chimneys; and in regard to the second, to the casting or stamping of either the inside or outside cylinder in one piece with the bottom and rim of the chimney-holder.

AMERICAN PATENT CASE.—SCULPTURING BY MACHINERY.

A very interesting exhibition was made a day or two since in the Circuit Court in the United States for this district, in two suits brought by Mr. A. K. Carter, of Newark, N. J., as agent of Blanchard's Gun Stock Turning-factory, against parties in this city, for an infringement of patent right. The machine is described, in the specification to the patent, as "an engine for turning irregular forms out of wood, iron, brass, or other material or substance which can be cut by ordinary tools," and was originally designed and applied for the purpose of cutting shoemaker's lasts, carriage spokes, boat oars, gun stocks, and a variety of other things; mostly wooden and metallic forms used in the purposes of mechanic art. A most striking application of the invention, however, and that which will most attract public notice, is that indicated at the head of the paragraph; the machine actually cutting, even to cameo size, and with life-like fidelity, *busts* out of solid and close-grained marble. Two beautiful pieces of sculpture were produced by Mr. Carter, in court—one a bust of Mr. Clay, the other of Mr. Webster. Both the judges, Grier and Cane, inquired with particularity whether it was possible that such statuary—bearing upon it the impress of the sculptor's celestial art—could have been made by the soul-less gouge of cold and regular machinery? "As your honours see it in court," said Mr. Lewis, jun., counsel for the plaintiff, "so came it from Mr. Blanchard's factory. Nothing has been used except a brush to wipe away the dust." Mr. Thomas Blanchard, the person represented by Mr. Carter, and the inventor of this machine, is a native, we believe, of Boston; in which city he resides. His invention was patented so long ago as 1820, but was never applied until now to any but the useful arts. In 1834, in consideration of the extraordinary merit of the invention, Congress passed a special Act renewing the patent for 14 years; but it was still applied only to utilitarian purposes: and even in regard to these Mr. Blanchard, as seems common with men of genius, appears to have taken very little pains to protect his rights. The recent application of the machine, is, however, an era in the history of invention. It makes the useful arts subserve the fine in a degree hitherto certainly unknown; and by multiplying (and perfecting of course) the applications of the invention, will cause, in turn, the fine arts greatly to subserve the useful.

The jury in the case brought in this circuit, and which were for the infringements of the patent in cutting shoe lasts, gave a verdict in favour of Mr. Blanchard, in one case of 1,344 dollars, and in the other of 850 dollars. The originality and validity of the patent had indeed been previously well settled by Judge Story and other eminent jurists in New England; and the defendants here, after resisting the claim for some years, on being satisfied of the clear rights of Mr. Blanchard, very properly abandoned the defence and referred the whole matter of damages to the jury; who, under the direction of the Court, found the verdicts we have already mentioned.

We may add that a specimen of the sculpture effected by this *last-making* or *gun-stock-cutting* machine is now in our office, where it was brought for an examination. It is the head of Mr. Webster, in marble,—small, but wonderfully complete and perfect in every feature and lineament; no statuary could have carved it out more beautifully: Truly, the machine that wrought it is most marvellous: but more marvellous still was the human genius that contained the machine.—*Phila. North American and Gazette.*

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal.*)

CURE FOR HERNIA, CALLED THE APPILATIVE. *Ovando Hurlbut.*

The patentee says,—"The nature of my invention consists in constructing an appilative composition, in the shape of the truss pad, to apply to ruptures, which composition gradually heals the parts, and continues to flatten down by the heat of the body as the cure proceeds. My remedy is composed of the following ingredients:—1. Take the bark of the root of the common hemlock (*Pinus Canadensis.*) 2. The inner bark of

white oak (*Quercus Alba.*) 3. Common brake root (*Pteris Aquilina.*) 4. The bark of green osier; all of equal quantities, and pounded finely in its green state, then mixed and put into an iron kettle; pour rain water on it till the powder is covered, then raise the temperature to 180° Fahr., and keep it constantly near the said degree of heat for three days; after this, throw the mass into a filter bag and let the fluid run off; keep the fluid, and put the drained mass into the kettle, pour water on it as before, and repeat the process till the maceration is completed. The fluids so obtained are mixed together, and the mass of the powder thrown away as useless. The said fluid is put into the kettle, the heat again raised to 180° Fahr., and kept so till it is evaporated to the thickness of syrup. In this state it is poured into tin pans, and exposed to the action of the sun or the moderate warmth of an oven, and continued at such a degree of heat till it attains the consistency of pitch, and it is then fit for use."

Claim.—" Having thus fully described my improved mode of treating ruptures, what I clam therein as my invention, and desire to secure by letters patent, is constructing an appilative composition formed in the shape of a truss pad, substantially as herein set forth, and employed and operating in the manner described."

FOR IMPROVEMENTS IN BRIDGES. *Horace Childs.*

The patentee says,—" In the construction of arch bridges with diagonal braces between the under and upper arch-pieces, the practice has heretofore been to abut the braces against the posts and arch-pieces at the junction of the two: so that the two braces, on opposite sides of each post, apply all the strain to the arch-piece at one point. This necessarily tends to break it at this point, and does not transfer the strain from one part of the arch to other parts—a result so important in a good bridge.

" The object of the first part of my invention is to arrange the diagonal braces between the lower and upper arch-pieces, or arch-piece and its chord, and at a sufficient distance within the posts and vertical connecting rods, as to make that portion of the arch-piece perform the function of a lever; the post or connecting rod being the fulcrum, and thus to transfer the strain applied to any part of the arch from one diagonal brace to another throughout the series, and in this way give to the arch-truss the greatest amount of stiffness due to the amount of timber employed.

" It is also well known that bridges are exposed to much lateral strain from wind, tending to force the arch-trusses over out of plumb; and as an arch loses much of its strength when out of plumb, it has become a matter of great importance to perfect a bridge against such tendencies. The second part of my invention consists in making the middle arch-truss of the bridge in two parts, inclined in opposite directions, connected together at top and separated at bottom, so that they resist the action of the wind in opposite directions."

Claim.—" What I claim, therefore, as my invention, and desire to secure by letters patent, is the employment of the additional nuts upon the suspension rods under the upper end above the lower stringers, substantially as herein described, whereby the suspension rods answer the additional purpose of counter braces, as described. And I also claim the employment of screw-bolts combined with the thrust-braces, and projecting beyond them sufficiently to pass through the stringers where they are united with the posts, substantially as described, whereby the brace-posts and stringers are bound together, as herein described."

IMPROVEMENT IN THE MANNER OF ACCUMULATING ICE AND COOLING WATER. *John Dutton.*

The patentee says,—" The nature of this invention consists in cooling water and accumulating ice, by compressing air to one-fifth its bulk, more or less, in any convenient manner, and causing it to suddenly expand to its original state, and come in contact with a body of water issuing from another vessel, and passing by the air outlet in such a manner that the water will be suddenly converted into ice, or a degree near it, on the general principle that air, by suddenly expanding, generates cold, its capacity for heat being increased."

Claim.—" What I claim as my invention is cooling and congealing water and other fluids by means of compressed air confined in the vessel, and conveyed through a tube provided with a cock, and surrounded by another tube provided with a cock, (and communicating with a reservoir of water,) and allowing it to suddenly expand, while surrounded with the water, in such a manner as to cool or congeal the water, on the principle that air, by suddenly expanding, absorbs heat, its capacity for heat being increased, as described."

IMPROVEMENTS IN BOOM-DERRICKS. *Albert D. Bishop.*

The patentee says,—" Instead of making the boom which sustains the weight that is being lifted, as heretofore, to project all on one side of a mast, which tends to carry over the whole apparatus, and which therefore has to be sustained by guy ropes, I make the boom to extend horizontally to an

equal distance beyond a short mast that turns in appropriate bearings in the upper part of a frame standard — this rear projection of the boom being provided with a brace rod, which is connected with the base of the standard by a roller, or rollers, and rail, to admit of the free turning of the boom. The rope by which the weight is sustained and raised passes over a pulley that has its bearings in a block that slides on two rails on one end of the boom, and moved from or towards the mast by two cords attached to the sliding block, one of them passing directly to and over a pulley let into the mast and through a hole therein; and the other passing first over a pulley at the end of the boom and then over another pulley on the mast, so that by means of these two ropes, after the weight has been raised, it can be moved towards, or from the mast; the lifting rope being passed also over a pulley attached to the mast and down through the hole therein. This arrangement will admit of turning the boom in any direction to deposit the weight at any point within a circle of which the boom is the radius. The standard is a triangular pyramidal frame, with a circular base provided with an inverted circular rail under which the roller of the brace rod runs, and with two sills to rest on, or by means of wheels to run on a permanent railway, to admit of moving the whole apparatus to any distance required by the extent of the work intended to be done; and the upper end of this standard is adapted to the reception and turning of the mast of the boom. The mode of framing this standard is good, and highly important as affording more stiffness and solidity for various kinds of structures than any other mode of framing with which I am acquainted. It consists of three posts placed at equal distances apart, and so inclined as to form a triangular pyramid, connected together by horizontal ties, and braced together by diagonal braces running in opposite directions and crossing each other; each set commences at the base of one post, runs up diagonally to the next, on one face of the pyramid, from the upper end of this brace another commences on the other face of the pyramid, and runs up at the same inclination to the next post, at the end of which, and on the third face of the pyramid, another commences and runs up at the same angle to the first post to complete the circuit, and so on to the top; the other set runs up in the reverse direction, and crossing the first. In this way the system of diagonal braces commences at the base, on each face of the pyramid, extending up to the top; the ends of the braces where they come together, and on opposite sides of each post, overlap, so that one bolt passes through the ends of four braces and one post."

Claim.—"What I claim as my invention, is making the boom to extend to the back of the mast, which turns in an elevated standard, in combination with the mode of bracing it by means of a brace-rod connected with the base of the standard by a roller and rail, to admit at the same time of turning the boom as described.

"I also claim the mode of constructing the standard, by making it of three posts tied together to form an equilateral triangular pyramid, in combination with the system of diagonal braces as herein described, whereby the structure is rendered stiff and unyielding, to resist vertical and oblique thrusts and all tendency to twist, as described."

Improvements in the Wire Cable or Chain Suspension Bridge. *John A. Roebling.*

The patentee says,—"My plan of anchorage differs very materially from the mode hitherto pursued. It is principally calculated for such locations where there is no rock and where an artificial anchorage has to be made. In most cases, the practice has been to resist the pressure of the anchor plates to which the chains or cables are attached, and which are continued below ground in a straight course,—directly by a large mass of solid masonry, constructed either in the form of arches or straight walls and butting against the abutments upon which the towers rest, which support the chains or cables. In this case, pressure is transmitted to a small surface of stone wall, which has to be constructed with great care and of the best of masonry: and as the base of this masonry is but small, its extent in length must be proportionally large, so as to offer the necessary resistance.

"In place of resting the anchor plate directly against the stone wall, I apply in any mode a system of timbers which serve in a manner as a foundation for the superincumbent masonry, distribute the great pressure of the anchor plates over a large surface of masonry, reduce therefore its length or depth, and by its yielding or elastic nature prevent the breaking of the anchor plates. I prefer curving the chain or cables below ground in place of continuing them straight. It is also my practice to surround all the iron below ground by hydraulic cement, and wall it in with solid masonry, in place of leaving an open channel, as is the case in most suspension bridges. The cement with which I surround the chains or cables preserves them against rusting effectually. Where greater precaution is desired, the chains may be enclosed in lead."

Claim.—"What I claim as my original invention, is the application of a timber foundation in place of stone, in connection with anchor plates to support the pressure of the anchor chains or cables against the anchor masonry of a suspension bridge, for the purpose of increasing the *base* of that masonry, to increase the surface exposed to pressure, and to substitute wood as an elastic material in place of stone for the bedding of the anchor plates. The timber foundation is either to occupy an inclined position, where the anchor cables or chains are continued in a straight line below ground, or to be placed horizontally when the anchor cables are curved. The whole to be in substance, and in its main features, constructed as described above, and exhibited in the accompanying drawings."

IMPROVEMENTS IN MACHINERY FOR CUTTING FILES. *Major H. Fisher.*

The patentee says,—"In devising machinery for cutting files, a difficulty hitherto insurmountable has been experienced, which results from the variation in the hardness or density of the metal at different points of the 'blank' to be wrought upon; or to state the difficulty more practically or specifically, where the piece of metal or 'blank' is softer in some points than others, the chisel will cut deeper in such points, and as the feeding motion is regular, the chisel at its next descent will strike in the groove previously made, and merely widen the said groove without forming another tooth. Serious difficulty has also been met with in accommodating the chisel edge to the 'wind' (so termed) of the 'blank' or the imperfection of its surface.

"These difficulties are avoided and surmounted by my improvements, my machine being so arranged as to imitate or perform automatically, as it were, the *manual* process which is now in vogue for cutting files, and which consists in placing the chisel edge in advance of a tooth which *has* been formed, and on the smooth part of the blank, and drawing it back until the operative feels the said tooth, when the blow is immediately given with a heavy hammer which forms its succeeding tooth and its adjacent groove. In my machine this function is effected by so arranging the chisel, that for each groove and tooth its cutting edge is made to *reach out* and *slide back* in a manner substantially analogous to the manual process above specified, the movement of the chisel being produced by mechanism."

THE SPRAY PUMP.

Sir,—Mr. Clive asks, "If I have not, in my calculation of engine power, left out the pressure of the atmosphere, as induced by a vacuum of 15 lbs. to the inch when perfect?" It is true, I did not mention the vacuum under which the engine at Tipton was worked, simply because I had no means of ascertaining the exact amount; but, if he will reconsider the subject, he will see that the load per inch on the steam piston was equal to the pressure of the steam above the atmosphere; hence the vacuum remained as a surplus power to overcome the tension, &c.

The experiments at Tipton and Llanhiddel show that water does not lose its gravity; nor can a greater quantity be raised by a given power by converting it into spray. This is in accordance with the first writers on mechanics, who assert, that to raise one pound or one ton to a certain height, the power expended (exclusive of friction) will be equal to the descent of one pound or one ton from the same height.

I am, Sir, yours, &c.,
CASSELL MORLAIS.

Merthyr Tydvil, Jan. 18, 1848.

INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting of this institution, for the election of officers for the ensuing year, took place on Tuesday last, the 18th inst.

The term of two years, for which Sir John Rennie was elected to the presidency (on the retirement of James Walker, Esq.) having expired, the most important business to be transacted at the present meeting, was the election of a gentleman to succeed him in the chair. The choice of the meeting fell unanimously on Joshua Field, Esq., of the eminent firm of Messrs. Maudslay, Sons, and Field. Mr. Field's claims to this high distinction cannot be better expressed than in the language of the retiring President, Sir John Rennie: "Mr. Field had been one of the founders of the institution, and had taken a leading part in its management for many years; he was universally respected and esteemed as an upright, honourable, kind-hearted man; he was of high celebrity as a mechanical engineer, particularly in that most important department, steam navigation; and his election would unite more firmly the two branches of the profession, which, to insure general prosperity, must ever go hand-in-hand, as they had hitherto done in the institution, in spite of all attempts to make it appear otherwise."

The thanks of the Society were voted by

acclamation to Sir John Rennie himself, for the admirable manner in which he had performed the duties of the presidency during his term of office. His uniform urbanity and courtesy—the tact and intelligence with which he had managed to give always as instructive and useful a bearing as possible to the discussions of the Society—and his unvarying candour and impartiality, were each in their turn, themes of just eulogium.

In a valedictory address, which was exceedingly well received, and which we hope at some future time to be able to publish at length, Sir John bore grateful testimony to the cordial support and assistance he had received at the hands of the members of Council for the past year, and of their able and efficient secretary, Mr. Manby. In the course of his address, Sir John alluded in a very pointed manner to the estrangement of the government—if estrangement it might be called—from the general body of civil engineers. Very rarely was a civil engineer appointed on any of the public boards and commissions; military engineers were constantly preferred to such appointments, simply because of their military rank, and not because of any superiority which they were supposed to possess in point of scientific knowledge or practical skill. The public service had suffered from this partiality, and, if persisted in, would suffer still more from it.

The following gentlemen were elected to be members of the Council for the year ensuing:—Joshua Field, Esq., President; W. Cubitt, J. M. Rendel, J. Simpson, and R. Stephenson, M.P., Vice-Presidents; J. F. Bateman, G. P. Bidder, I. K. Brunel, J. Cubitt, J. Locke, M.P., J. Miller, W. C. Mylne, T. Sopwith, J. R. M'Clean, and C. May, Members; and J. Clutton and T. H. Wyatt, Associates of Council.

INQUIRIES AND ANSWERS TO INQUIRIES.

Wire Gauges.—"Which is the best sort of wire gauge? —*B. P.*" That which is called "the Edinburgh gauge" is, we believe, the simplest and best. It consists of two straight bars of steel, divided on their inner faces into 100 equal parts, and united together at bottom, but at such a degree of divergence as to be half an inch asunder at the 50th division of the scale; so that if a wire, when dropped into the angular gap, stops at 10°, 20°, or 30°, it indicates that it is 10, 20, or 30 hundredths of an inch in diameter.

Double Achromatic Lenses.—"T. C. S.," who makes some inquiries (p. 69) about achromatic combinations, will find a long article by Biot—who knows more about such things than most people —in the 19th vol. of the "Mémoires" of the French Academy, which is, I believe, intended to be of practical use to workmen. I know a first-rate working optician, who got a friend to apply to Professor Airy, and two other of the first optical authorities of the day, for a formula or rule for working certain glasses to a proper shape; and they all gave results grossly differing from each other, and from the greatest limit of error he could even himself have committed *in practice*. I believe that this was not owing to their mathematics being at fault, but to their not rightly understanding the practical problem.—*H. N.*, Jan. 17, 1848.

Obligations of Secresy.—"I have made an important invention, which I am about to submit to the notice of a capitalist; and, as a preventive to fraud, I am advised to obtain his written promise to the effect that he will not, on pain of forfeiture of a stated sum of money, take any undue advantage of the invention, providing he does not come to some agreement. Will such a written promise be binding and effective? or, if not, what course would you advise me to pursue?"—Such a written agreement will be binding enough, and the forfeit money, if stated to be the amount agreed upon between the parties, as *liquidated damages* for breach of contract, may be recovered by an action at law. However, there is great difficulty in all such cases in obtaining evidence of the "undue advantage" taken: and the best security which an inventor can have, is to make sure that he is dealing with honourable and respectable parties.

Solid and Hollow Electro-Magnets.—"I fear lest your correspondent, 'J. F.,' Brighton, (p. 69,) may be misled by supposing that the removal of the interior solid of electro-magnets will not impair their power. I have tried and proved it otherwise. What he should do is to draw the iron into fine thin *square* wire, and let it be well anealed before covering it. I heard Dr. Scoresby lecture at Cambridge on the subject: his dicta were confined to common magnets polarized by traction or percussion.—*J. M.*"

Cambridge Mathematics.—Dear Mr. Editor,—I think you did wisely to put your veto on the discussion of the question respecting "Cambridge Mathematics," when it took the form prefigured by the initiatory remarks of "+," which you printed in the last number of your Magazine. I fully acquiesce in your decision; and I will add further—that had you printed his letter entire I should have felt it a degradation to reply to a person who could (in perfect ignorance of who I am, whether a Cantab or not,) have ventured to charge me with "personal prejudice" in the matter. *You*, at least, know that I am incapable of introducing "personal" feelings into scientific discussions, and I trust I shall ever possess that manliness and love of truth which would lead me to retire from any discussion where I found myself in error, without indulging in splenetic personal attacks upon my opponents. The truth is, that the readiness with which "+" applies such motives to me, only shows how conscious he is of being governed by such motives himself. An honourable mind does not impute unworthy motives to everyone who differs from him in opinion, whether the discussion relate to scientific truth or to social organizations. As to the "becoming" style of writing with respect to Cambridge, I shall always follow my own judgment in preference to that of "+." Having said this much, I resign into your hands, as the most able and most fitting, the office and title of "Your Reviewer."—[We do not think

that "+" can be fairly charged with absolutely imputing "personal prejudice" to our friend the "Reviewer," and still less with evincing "readiness" to do so. The words he used were these:—"Convinced that the language of the author of the articles alluded to savoured more of (I *might almost* prefix the word personal) prejudice than was becoming." At the same time, we rather take blame to ourselves for allowing the imputation to pass, even in the very qualified form it bore, without adding a note expressive of our own perfect conviction that "personal feelings" had nothing whatever to do with the strictures complained of.—Ed. M. M.]

Natural Bridge in Illinois.—In Jackson county, Illinois, on the south side of Muddy River, near Murfreesborough, there is a natural bridge, which is something of a curiosity. It is thrown across the bed of the rivulet from buttresses of nearly equal size, worn out of the solid rock by the water as smoothly as if cut by a chisel. The bridge is a solid block of limestone, 84 feet in the span of the arch from buttress to buttress, 22 feet above the bed of the stream, 15 feet wide, 7 feet thick in the middle, and about 12 feet thick at the ends resting on the two buttresses. The appearance of the whole is that of a modern stone bridge, except that the north end is a little lower and narrower than the other, though the inclination is not more than 2½ feet in its length on the top. It is 120 feet long, and firmly and conveniently set into the opposite banks, and over it is a good road for horses.

WEEKLY LIST OF NEW ENGLISH PATENTS.

John Gilmore, Lieutenant in the Royal Navy, for certain improvements in ventilating ships and other vessels. January 17; six months.

Charles Crane, of Stratford, Essex, manufacturing chemist, and James Thomas Jullion, of the same place, analytical chemist, for improvements in the manufacture of certain acids and salts, and a new apparatus applicable to the said improvements. January 18; four months.

Samuel Cunliffe Lister, of Manningham Hall, in the parish of Bradford, Esq., for improvements in stopping railway trains and other carriages, and generally where a lifting power or pressure is required. January 18; six months.

John Hickman, of Birmingham, for improvements in the means of constructing and connecting parts of bedsteads, couches, and other articles of furniture to which such improvements may be applicable, and also in the means of attaching knobs or handles to drawers, doors, and other parts of furniture. January 18; six months.

William Newton, of 66, Chancery-lane, Middlesex, civil engineer, for improvements in the manufacture of sugar from the cane. (Being a communication.) January 18; six months.

John Frederic Bateman, of Manchester, for certain improvements in valves or plugs for the passage of water or other fluids. January 18; six months.

Thomas Robert Sewell, of Carrington, in the parish of Basford, Nottingham, chemist, for improvements in preparing flour. January 18; six months.

Joseph Clinton Robertson, of 166, Fleet-street, London, civil engineer, for certain improvements in the manufacture of textile fabrics, stuffs, and tissues, and of certain new products obtained by the aid of such improvements. (A communication.) January 19; six months.

John Duncan, of Brentwood, Essex, gentleman, for certain improvements in tanning of hides. January 20; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Jan. 13	1320	Richard Stratton	Bristol	Tumbler cart for night-soil manure, gravel, &c.
,,	1321	John T. and H. Christy and Co.	London	The gutta percha hat.
15	1322	Henry Martin Aitken	Manchester	Improved horizontal scarificator for cupping.
,,	1323	William Herapath	Bristol	Universal coal-gas blow-pipe.
19	1324	Henry Tilley	Piccadilly	Self-acting blacking fountain.
,,	1325	John and William Dent and Co.	Wood-street, Cheapside	Glove finger-end.
,,	1326	Thomas Ball	Enfield	Portable suspending and revolving oven.

Gutta Percha Company, Patentees,

Wharf-road, City-road, London.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in Bands of an indefinite length, render them superior for almost all working purposes, and decidedly economical.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Haslingden, September 4, 1847.

Dear Sir,—We have now been using the Gutta Percha Straps for the last eight months, and have great pleasure in saying they have answered our most sanguine expectations; and we may add, that some of our machines which required a 12-inch leather strap, and which almost daily required to be repaired, we have been turning the same with the Gutta Percha Straps 10 inches only for the above-named period, and now find them as good as the day they were first applied.

We remain, yours respectfully,

W. & R. TURNER.

To S. Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

Sir,—In reply to your inquiry as to the result of our experience with the Gutta Percha Straps, we have great pleasure in stating that the advantages they possess are so very manifest as to induce us to apply them in almost every instance where new straps are required.—We are, Sir, very respectfully,

SHARP, BROTHERS.

Samuel Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

Sir,—In reply to your inquiry respecting how we like your Gutta Percha Machine Straps or Driving Belts, although we have not had quite so much experience in the above-named use of Gutta Percha as we hope to have, so far as we have employed it, it has given us general satisfaction. The beautifully straight and regular manner in which it runs on the pulleys, especially on our cone or speed pulleys, is a strong recommendation in its favour; and although we are inclined to think it does not take so fast a grip on the pulley as leather, yet there is ample hold for all general purposes. We shall continue to use it and to give it our best attention, so as to learn how to employ to best advantage the many excellent qualities it possesses over the ordinary leather belts.

NASMYTH, GASKELL, & CO.

S. Statham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

Dear Sir,—We beg to inform you that we have now had the patent Gutta Percha Bands or Straps in use for more than six months. For tube frames we consider them very much superior to anything we have tried before. They also do very well as open straps for mules, throstles, looms, &c.

We are, Sir, yours respectfully,

THOS. DODGSHON & NEPHEWS.

Mr. Samuel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

Gentlemen,—We have much pleasure in bearing our testimony to the valuable qualities of the Gutta Percha for driving bands. We have found it answer exceedingly well in most cases where we have tried it, and we think it has only to be made known to ensure its very general use.

We are, Gentlemen, yours obediently,

HOLE, LINGARD, & CRUTTENDEN.

To the Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

Dear Sir,—Your letter of the 31st August is to hand, and in answer respecting the use of your Gutta Percha Bands, I cannot give you a better proof of our approval of them in preference to leather straps, than having given an order for another to your partner, yesterday, to be in readiness in case of accident. They are decidedly preferable to the old straps; and we can recommend them with the greatest confidence to any person for Driving Straps.

For HALL & GORTON, THOMAS GORTON.

S. Statham, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.

Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.

TRUMAN, HANBURY, BUXTON, & CO.

To the Gutta Percha Company.

Patent Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton-row, 1st Sept., 1847.

Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.

C. WRIGHT, Boot and Shoe-maker.

To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.

Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

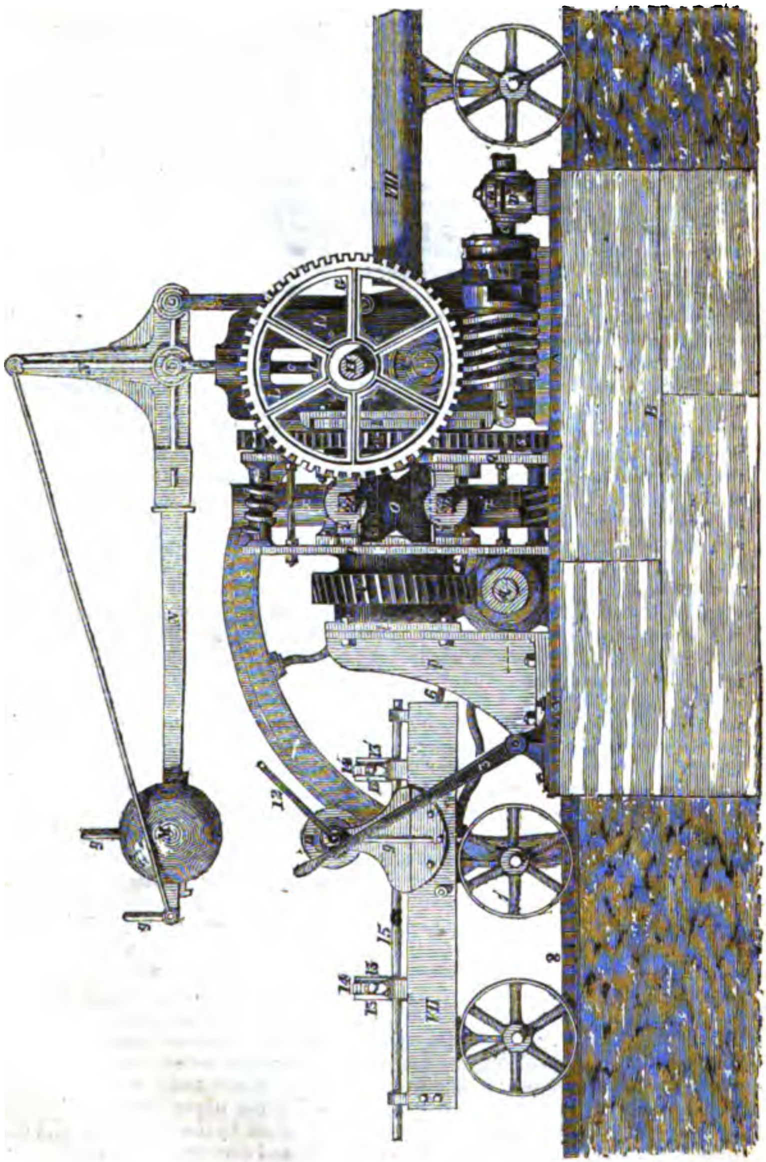
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1277.] SATURDAY, JANUARY 29, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166 Fleet-street.

MELLING'S IRON BAR TWISTING MACHINE.

Fig. 1.



MELLING'S IRON BAR TWISTING MACHINE.

In volumes xlv. and xlvi., we gave an account of various improvements connected with steam engines, railway locomotives, &c., patented by Mr. Thos. Melling, of the Rainhill Iron-works (near Liverpool.) One of these consisted in manufacturing the shafts, connecting rods, axles, tyre-bars, and other similar parts of machinery of several rods of iron *twisted together* (after the manner in which ropes are spun,) instead of making them of one piece, as usual. That there would be a great gain in strength by such a mode of manufacture, was not, we believe, questioned by any one; but it was supposed by some—not without apparent reason—that the difficulty of the operation, arising from the intractibility of bar iron, as compared with rope or wire, would prevent it from coming into general use. We are happy to say that this difficulty has been completely overcome by the ingenuity and perseverance of the patentee. He has constructed a machine for the purpose, and had it for more than a twelvemonth in full operation, which is of such power, that bundles of strong iron rods are twisted together by it, with as much facility as if they were so many reeds. The iron is first piled up in bars, then twisted by the machine, and subsequently finished by hammering and rolling to any required form. From the accompanying engravings of the machine it will be seen that there are two pairs of rollers, which receive the bars to be twisted. One of these pairs, or the "delivering rollers," rest in two cheeks, and simply revolve upon their own axes; whilst the other pair, or "revolving rollers," have not only a motion about their own axes, but also revolve, along with the plates by which they are carried, in a plane at right angles with the bar to be twisted. The bar, or pile of bars, being passed through the revolving rollers, and between the "delivering rollers," the upper delivering roller is then pressed upon it, either by a lever and weight, (as shown in fig. 1,) or by a screw, (as in fig. 4.) Being thus prevented from turning at one point by the delivering rollers, and forcibly carried round at another by the revolving rollers, it is obvious, that between these points a twist must take place; whilst the revolutions of both pairs of rollers upon their own axes at equal rates of speed, not only serve to carry the pile of bars forward, but to keep it perfectly straight, without any unequal stress being imparted to any portion of the pile.

Fig. 1, is a side elevation of the machine, with the carriages for conveying the bars to and from the furnaces, &c.: a portion of the driving gear being omitted in this view, in order to show the other parts more clearly.

Fig. 2, is a plan. In this view the principal parts of the machine are shown in section, and the whole of the driving gear is exhibited.

Fig. 3, is an end view, taken from the end at which the bars are delivered, or looking upon the delivering rollers.

Fig. 4, is a side view of the delivering rollers and cheeks, detached from the rest of the machinery, showing how the position of the upper roller is regulated by a screw, instead of by a lever and weight, (as in fig. 1.)

Fig. 5, is a front view of the revolving rollers, showing the movement by which the revolution about their own axes is obtained.

A, is the bed-plate of the machine; B, the stone foundation upon which the bed-plate rests; C, the driving shaft, to which the power is first applied; D, D′, D″, pedestals attached to the bed-plate, for carrying same; EE′, the delivering rollers.

From the driving shaft, C, motion is communicated to the lower delivering roller, E′, by the worm F′, the worm-wheel G, the shaft H, and the two spur-wheels II. The object in giving motion to the lower roller first, is to leave the upper one at liberty to be raised or lowered, as circumstances may require. JJ′, are two standards, carrying pedestals, in which the shaft H, works; KK′, are two spur-wheels, which communicate motion from the lower to the upper delivering roller. The journals of the delivering rollers work in four plummer-blocks, a, a', a'', a''', which rest in two cast-iron cheeks, LL. These cheeks are bolted, and farther secured by keys, to the bed-plate, A. The pressure upon the upper delivering roller, E, is obtained by the weight, M, and the lever, N, and communicated to the plummer-

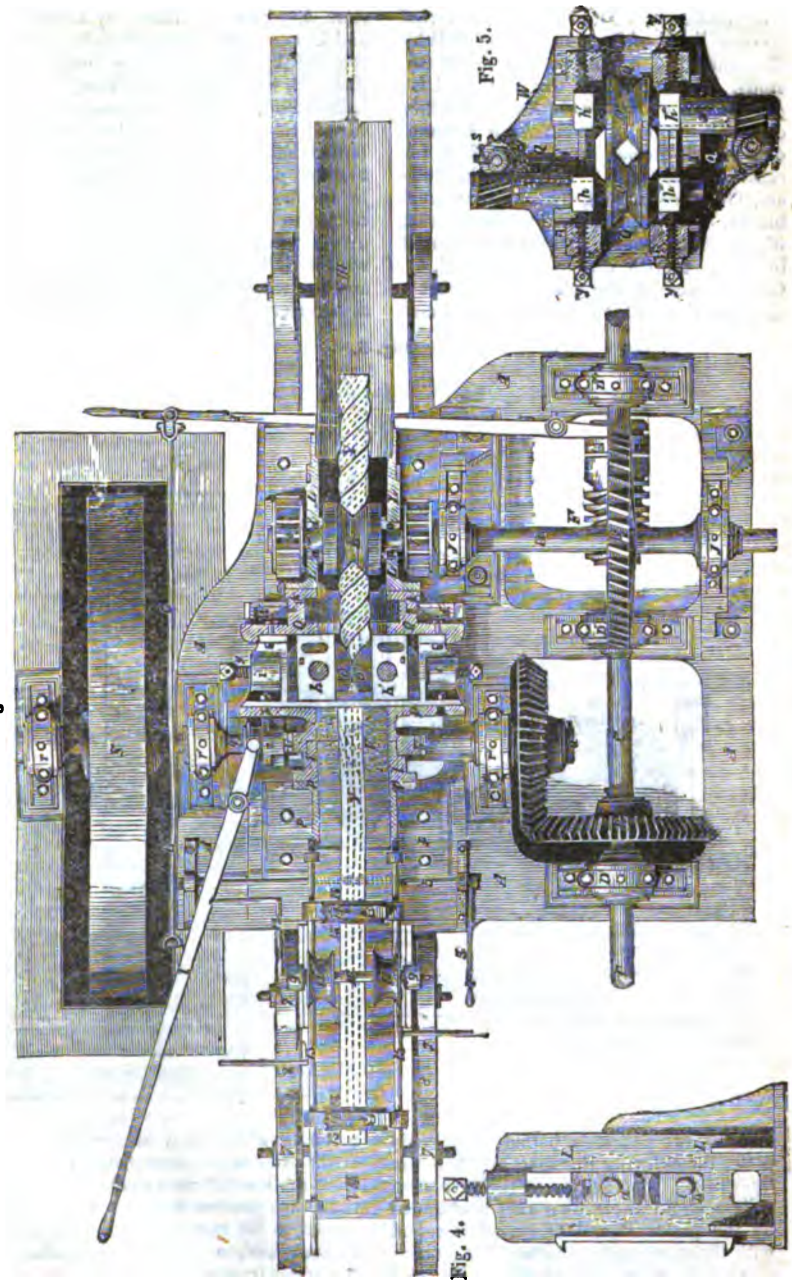


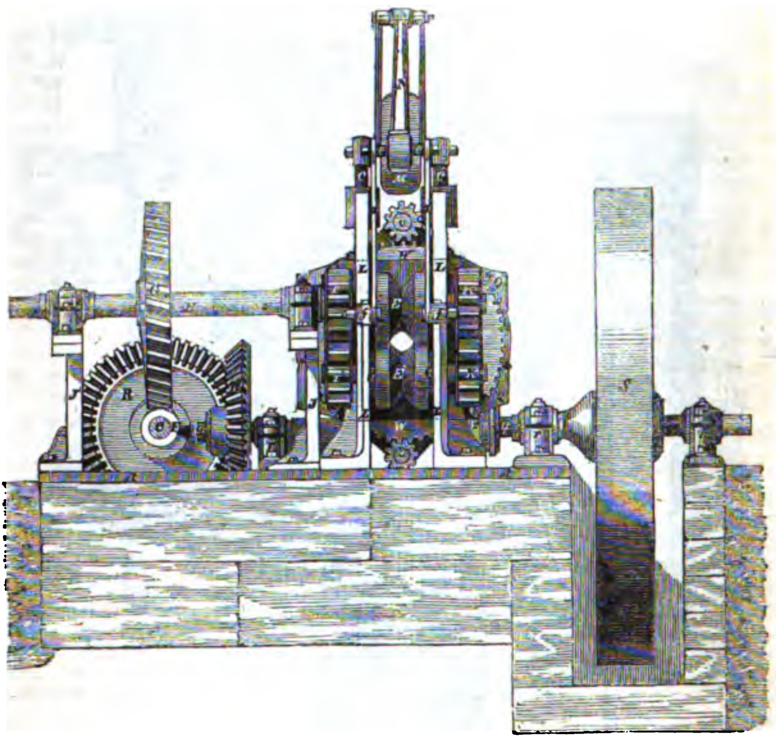
Fig. 2.

Fig. 4.

Fig. 5.

blocks, aa', by the centre pin, b, and the two spindles, cc' The lever, N, is carried by two links, dd', connected with it by the centre pin, e, and working upon two studs, ff, inserted in the cheeks, LL; gg, are two wrought-iron loops, to either of which a rope or chain from a crane, or a pair of blocks, may be attached, for raising the lever, N. The revolving rollers, OO', are carried, by four plummer-blocks, h, h', h'', h''', fitted to two cheeks, ii', which are bolted, and further secured by keys, to two cast-iron plates, P, Q. On the back of the plate, O, is cast a circular ring, which is truly turned and fitted into a corresponding plate or carrier, k, which is affixed by screw-bolts and keys to projecting flanches cast on the cheeks, LL. On the back of the plate, P, is cast a worm-wheel, U, which is bored out, and works upon a carrier, l, turned to correspond. The carrier, l, is bolted and keyed to a strong cast-iron bracket, p, which is also bolted and keyed to the bed-plate, A. Motion is transmitted to the revolving rollers from the driving shaft, C, by the pair of mitre-wheels RR', the shaft q, the worm V, and the worm-wheel U, which wheel is, as before stated, cast fast to the plate P

Fig. 3.



r, r', r'', are pedestals bolted to the bed-plate, for carrying the shaft q; S is the fly-wheel. The motion of the revolving rollers about their own axes is obtained by the plates P and Q carrying round with them two spur pinions, s', s'', which work into a fixed toothed rim W, and thereby obtain a motion round their own centres, as well as the motion round the machine which they derive from their connection with the plates P and Q. The motion of the pinions ss', round their own centres thus obtained, is transmitted to the revolving rollers by the two worms, ww', on the pinion s afts, and the two worm-wheels xx', on he roller shafts. y, y', y'', y''', are screws for regulating the revolving rollers according

to the size of the bar; and zz', stays for keeping the plates, P and Q, at the proper distance from each other.

The machine, in fig. 2, is represented as thrown out of gear whilst in the act of twisting a bar, Y. This disengagement is effected by removing, by the levers, II, the clutch-boxes, 22', from the corresponding clutches cast on the worms, FV, these worms being loose upon their shafts. The office of the levers 3 and 4, the shaft 5, and the rod 6, is to enable the attendant to engage or disengage the delivering rollers whilst at the opposite end of the machine. VII, is the carriage for conveying the bars from the furnace to the machine; it is mounted upon four wheels, 7, 7', 7'', 7''', which run upon a tram-road 88'. To the body of the carriage are affixed, by bolts and nuts, two brackets 99', which carry a cross shaft 10, and two pullies 11 11'. Round the two pullies, 11 11', are coiled chains for drawing the bars out of the furnace, the ends of these chains being attached for that purpose to a box, which is slipped over the end of the bar whilst in the furnace. The ends of the shaft, 10, are square, to receive a handle 12, or, if necessary, a handle may be attached to each side the carriage. 13 13', are two guides for supporting the pile of bars to be twisted, and which also serve to keep the several bars together. To admit of these guides 13 13', moving freely round with the bars, they are turned on the outside, and fitted into two cast-iron rings 14 14', which are bored to correspond. These rings are put together in halves, much in the same way as in the ordinary eccentric strap, and are carried by two rods, 15 15, connected with the body of the carriage. VIII, is the carriage for receiving the bars when twisted, and conveying them to the hammer and rolls; it is simply a semicircular trough, mounted on a pair of wheels, with a handle for moving it about.

It has been found that railway tyre-bars thus formed, besides being much stronger than others, possess this further advantage, that they neither wear flat nor spread out at the edges. Mr. Melling proposes to improve them still further, by making the inside body of each pile of iron, and the outer of steel. The exterior of the tyre would be thus considerably hardened, without their general strength being at all impaired.

Another advantage peculiar to these compound bars, independent of their superior strength, is exemplified in their application to piston rods, air-pump rods, and other like parts of machinery which have to work through stuffing boxes or in guides. When such rods are manufactured out of single pieces, with the grain running all one way, they are very liable to become grooved; but when made of Mr. Melling's twisted bars, the grain of the metal being brought into a position almost at right angles with the line of motion, the tendency to grooving is completely counteracted.

REMARKS ON THE PROBLEM OF THE GENERAL SOLUTION OF ALGEBRAICAL EQUATIONS. BY PROFESSOR YOUNG, BELFAST.

Notwithstanding the arguments which have been furnished by Abel and Hamilton, in disproof of the existence of any general algebraic formula for the roots of equations beyond those of the fourth degree, several analysts of eminence continue occasionally to occupy themselves in the search for such a formula. This is to be accounted for on the ground that the arguments adverted to—like nearly all attempts to prove the *negative* of a proposition of which the affirmative is entirely consistent with pre-established truths—seem to leave certain objections to them, that might be advanced, unanticipated and unprovided against. The proposition, too, demonstrated by Cauchy and others, that every equation has a root, tends to encourage misgivings as to the entire conclusiveness of the negative proof; chiefly, perhaps, because the limitations necessary to Cauchy's theorem are apt to be overlooked.

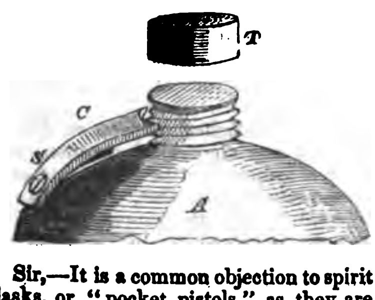
I have thought that it might not be wholly useless to suggest to those engaged in the researches here noticed, that, independently of all arguments in favour of the negative proposition, there is strong *à priori* probability against the existence of the general formula sought, as will, I think, appear from the following considerations.

Every symbolical expression for the roots of any algebraical equation, with general symbols for the coefficients, must of necessity be such that, when it is substituted for x in the proposed equation, the two members of that equation will become absolutely identical, whatever interpretation be given to the symbolical coefficients. Cauchy's proof, it will be observed, extends only to equations whose

coefficients are of a certain prescribed form. It would be impossible, in a general formula for the roots—a formula necessarily involving all the symbols which stand for the coefficients—it would be impossible, from the very comprehensive and non-exclusive character of analytical forms, to forbid other interpretations of the component symbols: the *identity* of the two members spoken of above, is an identity of purely symbolical expressions, irrespective of all arbitrary interpretation, and holds for *all* interpretations, however novel or extravagant. If the general expression for x, in the equation $x^2+ax=b$, be substituted for x, the identity of the two members remains undisturbed, whatever meanings, however fanciful, we give to a and b; and so of the cubic equation, &c. When, therefore, we seek for the general solution of an equation of the fifth degree, we presuppose the existence of an expression involving arbitrary symbols of so very general a character, that when substituted for x in that equation, the two members will become identical for all values that can be imagined of the said symbols. It certainly appears more remarkable that such a supposition should be confirmed in the inferior equations, than that it should prove erroneous in those more advanced in degree. It is no doubt unfortunate that, in the matter in question, the unavoidable generality of interpretation to which our symbols have claim, prevents their accomplishing what we exclusively aim at, without at the same time accomplishing a great deal more; so that, if these superfluous offices prove impossible, those that are actually required are made to bear the marks of impossibility too.

Belfast, Jan. 20, 1848.

IMPROVEMENT IN SPIRIT FLASKS.



Sir,—It is a common objection to spirit flasks, or "pocket pistols," as they are sometimes termed, that, however well they are "charged," they will often "hang fire;" in fact, that it is impossible to drink conveniently, from the only outlet being covered by the mouth.

The addition of a simple appendage will enable the wearied traveller to refresh himself without any of the difficulties at present attending the process.

A, is the upper part of the flask; B, is a screw; at S, is attached a slip of elastic metal, carrying a small slice of cork at C, which, when the top, T, is off the flask, will be in the position indicated in the sketch, and thus open a communication with the atmosphere by a small hole under C. When the top is screwed down, it will press on the end of the metal slip, and securely close the hole, by shutting the cork upon it.

I am, Sir, yours, &c.,

JOHN MACGREGOR.

Jan. 15, 1848.

SUPPLEMENTARY CHAPTER ON ANALYTICAL GEOMETRY. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[*Vide supra*, pp. 82—83.]

The following references to my "Chapters on Analytical Geometry" and to their contents will probably be found convenient to the readers of this work:

I shall close this series with an observation upon the second section of Chapter I., so far as it relates to the equation‡

$$\sin\theta=\theta-\frac{\theta^3}{1.2.3}+\&c.,$$

an equation upon which some no doubt

* I would also refer to the note which (vol. xlvi., p. 245) introduces Chap. II.; and to the correction required in the title (Ib. p. 271, 1st column).

† This Chapter contains two Theorems by Professor Young, of Belfast.

‡ *Mechanics' Mag.*, vol. xlv., p. 365, col. 1.

very proper comments have been made in this Magazine.* All that was meant to be suggested in that section might very readily be inferred from the circumstance that the three equations,—

Sine of a right angle is equal to unity;
Sine of 90° = unity;

$$\text{Sin}.\ \frac{\pi}{2} = 1;$$

have the same essential signification, or that the equation in question may be written

$$\text{sine of } \frac{180.\theta}{\pi} \text{ degrees} = \theta - \&\text{c}.$$

This would have been quite sufficient for my purpose—which was that of illustration only.

2, Church-yard Court, Temple, January 21, 1848.

INTRODUCTION OF STEAM NAVIGATION INTO AUSTRIA.

The first attempts to navigate the Danube by steam were made by some French and German engineers, who were so confident of success that they did not even try the vessel, but at once invited the Emperor, Francis I, to honour them with his presence on their first trip to Pesth. His Majesty safely embarked, and a most favourable passage was made *down* the stream; on arriving at Pesth, with his Majesty on board, the vessel created no little sensation—salutes were fired from all the batteries, and the curiosity evinced was intense; and, to celebrate the great event, public balls and other festivities were given. At the end of all the joyous proceedings, his Majesty intimated his intention of returning to Vienna. But when orders were given to "go on with all speed," to the astonishment of all it was found that the engines had no power,—that the stream was carrying the boat down the river. All attempts to propel the boat against the stream proved ineffectual, and his imperial majesty was obliged to land, and proceed to Vienna through a country where the roads were so bad, that the carriage frequently stuck fast in the mud. The parties from this defeat were induced to believe that to navigate the Danube by steam-vessels was impossible, and this opinion was corroborated by "eminent engineers" of Vienna. In 1830, Mr. J. Pritchard, a Woolwich Dockyard shipwright, arrived in Vienna with a companion, named Andrews, as interpreter, who, after examining the currents of the Danube, announced to Baron Putton, an influential banker in Vienna, that he saw no difficulty in effecting the desirable object. This enlightened nobleman, knowing the advantages to his country which must arise by carrying out such an undertaking, at once supplied Mr. Pritchard with the requisite capital for a second attempt; and orders were given to Messrs. Boulton and Watt for the engines, which are at present working as well as they did on their arrival first in Austria. The "learned" Viennese continually asserted that the second attempt would be only money thrown away, and not unfrequently was Mr. Pritchard taunted while at his work. With persevering energy, however, he completed his ship; the engines having arrived from England, were properly fitted; and, all being ready, Mr. Pritchard took the command, accompanied by his supporters only; those who had been previously defeated in their attempt were content to remain on shore, expecting to have a hearty laugh at the Englishmen. Mr. Pritchard, however, brought his charge into the rapids near Floridorf, and, to the general astonishment, cleared them in gallant style. Mr. Pritchard returned to Vienna, where he was well received; the ship was visited by the Imperial family, and permission given to name her *The Francis the First*. A concession was then granted by the Austrian Government to Mr. Pritchard for the exclusive right of carrying on steam navigation on the Danube for 15 years. A company was then formed; but, from some mismanagement on the part of Pritchard and Andrews, the company got hold of the concession. Andrews contrived to obtain about £6,000, while Pritchard, the successful practical man, resides near Fiume, nearly destitute.—(*From a Correspondent.*)

"WHEWELL'S MECHANICS"—LAST EDITION.

Sir,—In the articles "On the Use of Mathematics to Engineers," &c., I ventured to make some observations on "Whewell's Mechanics," pointing out what I considered its chief defects, and also alluding to the unaccountable deterioration of the book by the author himself in the 6th edition. On seeing a 7th edition advertised, professing to have "extensive corrections and additions," I was induced to look over this new edition. As I have not the sixth edition by me, I cannot compare this last with it; but the reader may infer something as to the relative merits of the *fifth* edition, (the one recommended in the articles alluded to,) and this new one, from the circumstance that the 5th was a volume of 326 pages, and the 7th contains only 191 pages. If, then, this latter has the advantage of "extensive corrections and additions" over its predecessor, No. 6, it is a natural corollary that the relative merit of Nos. 6 and 5 may be expressed by a very small fraction indeed. It is curious to trace the relative *prices*, however. No. 5 was published at 10*s*. 6*d*.; No. 7, is 9*s*., and the unfortunate cut-down No. 6, was 7*s*. 6*d*. It follows clearly that the *price* is by no means a *measure* of the *value*; the "law" connecting the two must be expressed by the logarithmic curve, or by some such means as will indicate to the unsuspecting public the fact that half a guinea will be much better spent on even a second-hand copy of No. 5, than on a bran new No. 7.

But leaving such mercenary considerations, let us look at the contents of the book. And in the first place, one turns naturally to the Preface, to see what excuse the author can make for his past delinquencies, and to what extent his repentance may be considered sincere as testified by replacing the "articles" he himself had stolen from himself. No one writes better Prefaces than Dr. Whewell: they are decidedly his *forte*. The Master of Trinity is also a master of the

* *Mechanics' Mag.*, vol. xlvi., p. 298. Consult also, on the same subject, vol. xlvii., pp. 231—232.

English language—and not Lord Brougham himself could better defend any whim he may have taken into his head—or old Sam Johnson ennunciate small truths and eke great errors, in more sonorous tones. An unguarded reader would as assuredly be taken in by this majestic array of words as —— *the author himself*. They are very pleasant reading indeed are these Prefaces, and would be pleasanter if pretty nearly the same ideas were not eternally repeated in them all—and not in them only, but in all the author's writings whatsoever. Now, some of these whims are harmless enough—but others are whims of infinite mischief, and one of the most pernicious is that to which, as might be expected, he clings with the most desperate tenacity; namely—the excellence, advantage, propriety and fitness, of founding the science of mechanics on the lever. The author is evidently well aware that he stands alone in this whim, and accordingly he pours forth some of his usual eloquence in defence of his pet doctrine:

"It appears to me highly desirable, in mechanics as in geometry, to preserve the early and historical form of the more elementary propositions. It is in dealing with these historical forms, that the mechanical ideas of speculative minds have from age to age been unfolded into clearness and distinctness: and a knowledge of these forms of reasoning is therefore highly valuable, as giving the student a share in the historical progress which the mind of man has made in these lines of speculation. This advantage is lost if we adopt some new mode of beginning the study of the subject, even if the new mode be more philosophical than the old, which its novelty may often make it seem to be, when really it is not so. In order to secure this advantage to our students, there ought to be a *permanent portion* of the subject of mechanics, which shall not change with the changing views of each race of mathematicians; nor will the existence of such a permanent portion of the subject impede the cultivation of the progressive portion of the science, any more than the study of Euclid impedes the study of Monge and Legendre. In this permanent portion of mechanics we must, I conceive, begin our reasonings concerning forces, *with the Lever*, and deduce the other properties, as, for example, the composition of forces from the lever; we must prove the properties of the centre of gravity in particular and simple cases, before we proceed to the general case; we must prove the laws of falling bodies, of projectiles, and of oscillating pendulums, by particular methods of summation, detached from the general methods of the differential calculus and from any other mode of treating central forces in general; since all general methods belong to a stage of intellectual discipline for which the permanent and elementary portions of science are only a preparation. I have accordingly taken the course I have thus described; and I am persuaded that we shall very fatally damage the effect of our mathematical studies as an intellectual discipline, if we ever adopt a course in which we disregard these long-accepted proofs, and urge our students to rush from the first into general methods, and to occupy their minds with novel modes of contemplating elementary truths."

I have hardly had patience to copy all this. There is so much that is true and reasonable mixed up with the wretched lever mania, that those who only read such special pleading carelessly will be very apt to accept the whole for sake of the fact—like forgers who pass off one bad coin amongst a heap of good ones, Dr. Whewell gives us much that is very rational, and this absurd lever whim in the middle of it. I entertain as high an opinion of the value of an historical acquaintance with science as perhaps Dr. Whewell himself; but let this acquaintance be made in a proper place. In an Elementary Treatise, Dr. Whewell will confess, I presume, that the primary object is the conveying clear and distinct views of the nature and grounds of the science treated of, as well as carrying out the details by the simplest possible reasoning. Now, the considerations involved in the theory of the lever are not at all likely to give a beginner any idea whatever of the real nature of the science he is commencing. I shall not soon forget the unutterable disgust which I felt on first attempting to read "Whewell's Treatise on Mechanics:" it was infinitely unsatisfactory —and so long as I was confined to that book, and like every beginner, dependent, of course, on others for whatever views I had—so long the whole subject seemed to me a miserable collection of detached scraps, unworthy the name of a science, and repulsive in the extreme. The properties of one single machine are obviously unfit to perform the office of a general foundation for a whole science of mechanics. The parallelogram of forces presents much more the character of such a principle as we naturally look for; but even this ought not to be put on the first page of a Treatise and without preliminary observations. But the clumsy series of axioms and propositions into which the student of Whewell's book is plunged at his very entrance, are most admirably calculated to give him a thorough loathing and nausea for the whole subject; and I doubt not some scores of students could corroborate what I am saying by their own experience. As to the advantages to be derived from keeping to the historical order, the argument is here completely misplaced and good for nothing. There is not one tittle of evidence to prove that "men's minds" only get at the parallelogram of forces through the medium of the lever; or rather, there is plenty of evidence to the contrary. Dr. Whewell may, if he likes, by a forced and unnatural method, deduce the parallelogram of forces from the lever—but *it is* forced and unnatural, and has neither sense nor history to support it.

And then, if we are to follow the historical order, why does not Dr. Whewell introduce Stevin's inclined plane with a chain

round it,—from which that worthy mathematician deduced the properties of several machines, and which method is so lauded by Whewell himself in his "History of the Inductive Sciences?" Why not make the unlucky reader wade through the methods of Huyghen's and the Bernoullis for finding the centre of oscillation, before coming to the modern *and simple* method? In short, Dr. Whewell could not keep to his own plan for two steps together without such monstrous absurdities as would outrage even his own notions of propriety. Let the student learn the history of the science by all means, and one of the first results of that knowledge will be a hearty thankfulness for the comparative simplicity and clearness of modern methods and ideas. When puzzled in any portion of my reading, I have frequently referred to some of the older writers on the same subject, but, with very few exceptions, the result has been as I have stated—and I believe those who have tried the same course will be able to give the same opinion. This historical knowledge, however, is not for the beginner, but for those who have a considerable acquaintance with the subject. To the former it is generally useless, and to make him wade through the mud of antiquity and grope his stumbling way through the darkness of bygone ages, when men were only beginning to feel thair way inch by inch—this is perfectly insane and ridiculous. Mathematics is difficult enough, in all conscience, as it is, without enveloping it in the additional obscurity which necessarily clouded the early dawn and first travellers in the unexplored regions, of Science.

The introductory portion of a work on mechanics ought to enter a great deal more fully than is usually done into the real meaning of such things as "the *measure* of a force," &c. The few words bestowed on this introductory portion by most writers make but little impression on the mind of a beginner, and, indeed, are evidently written without that consciousness of the importance of the subject, which one would think must have been forced home to the mind of every one who has witnessed the endless blunders and inextricable confusion, which the want of distinct notions on these points invariably produces. Statics and dynamics are the first branches of physics to which the student applies his pure mathematics; and here it is that he should be taught the general principles on which such application depends. But though the most perfect branch of natural philosophy, mechanics, is far from being the only one in which such a knowledge is necessary; and if correct notions were once acquired in studying this branch, they would be found of inestimable value throughout the whole course of future reading, or even experimenting, in such branches as electricity, &c. The value of such knowledge is by no means confined to the merely mathematical student—it ought to form part of the education of every one engaged in physical investigations, of whatever kind.

The vague and misty notions of "force" under which the great majority of popular writers and experimenters so obviously labour, are in the highest degree detrimental to the progress of science. It was the want of clear views on this matter that plunged mathematicians into the celebrated "vis viva" controversy; and the same obscurity will be continually productive of similar effects, so long as, by a defective education, it is allowed to exist. There is no need for a man to be a mathematician in order to become a good physical inquirer; but most assuredly his researches would be immeasurably more beneficial and instructive—would have a more definite aim, and be pursued in a more rational spirit—if he has previously acquired clear conceptions o. the mode in which physical forces can alone be submitted to either experimental measurement or mathematical calculation. It is very greatly to be regretted that in this country there is so marked a separation between the experimenter and the theorist. Whatever superiority the French have had, or now have, is due in a considerable degree to the circumstance that most of their practical men have received at their "Ecoles Polytechnique," to some extent at least, those clearer and sounder views to which I refer.

I have abstained from taking any part in the more recent controversy in your pages as to the Cambridge course; but I take this opportunity of expressing my conviction, that even there, experimental knowledge might be introduced with the greatest benefit, whatever be the light or aim in which the education there is contemplated. It is next to impossible to acquire any knowledge worth anything of such subjects as astronomy, optics, (both physical and formal,) &c., &c., without experimental illustration: moreover, there are scores of undergraduates who would be delighted with such knowledge as this, who, under the present state of things, content themselves with cramming (and with what nausea they themselves only can describe!) sufficient for a poll or Jun. optime degree. I contemplate no such absurdity as making them all chemists or practical astronomers of first-rate skill; but they might at least acquire a practical familiarity with the *alphabet* of such things, and which mere reading can never teach.

I remember a man who was preparing for the "poll" degree, to whom I showed the simple experiment of a syphon's action, and who caught the true explanation at once, and was unspeakably delighted with it. He had "got up" the thing in his cram-book, so as to "write it out," with the usual amount of labour and disgust; and *now*, lo! and behold, he *understood* it—all of a sudden, and was as proud of his new acquisition as Archimedes himself, running half crazed through the streets, shouting "Eureka." One is constantly reminded by such instances of the old verse, which the university would do well to act upon:

> "Segnius irritant animos demissa per aurem
> Quàm quæ sunt oculis subjecta fidelibus, et quæ
> Ipse sibi tradit spectator."

It must be acknowledged that the university has recently shown a readiness for improvement highly creditable, when the proverbial inertia of large public bodies is considered; and, in justice to Dr. Whewell, it must also be acknowledged that he is not by any means the last to advocate such improved measures. It is to be hoped, however, that the university will not stop short; for the step already taken is *but a step*, which must be followed by several others before *the public* are at all likely to feel the benefit of the change; and the public certainly will be so benefited, if instead of turning out every year a set of men who merely have a quantity of mathematical results and formulæ in their head, of which they hasten to disburden themselves as fast as possible—if, instead of these men, fatigued and disgusted by an incessant toiling, which, after all, is productive of no real love for science, and not even of any but very narrow and cramped views in mathematics itself,—if, instead of these, I say, the abilities wasted on too wide an extent of mathematical reading be concentrated on a smaller portion, which shall be better understood—and if a love for science can be implanted in place of a mere cramming for a high place—there will be some chance of such men cultivating science *after* leaving college, and so contributing to the general share of scientific knowledge. On the present system, I have no hesitation in saying that I never knew or heard of any one man who ever *acquired* such a love for science *at* the university. I know something about a good many of those who have done something since leaving college; and in every such instance that I am acquainted with, the interest in scientific pursuits has been felt *before* entering the university. I could name at once quite a sufficient number to bear out this assertion, which will not be required, however, by those who know anything of the university. It will be said, that it is not the *intention* of the college course to make men of science. Well, then, the only reason for requiring mathematics at all, must be as an "intellectual discipline." Now, setting aside the fact that it is almost impossible to make the study of mathematics have even this effect, unless a *real* interest be felt in it, I contend that the training will be of a much more likely nature to "discipline the intellect," by compelling each student to acquire a thorough knowledge of some few subjects, than by a hasty run through a greater number. There may possibly be one or two now and then, who, from an unusual previous preparation, and by dint of suicidal fagging whilst at Cambridge, acquire a really rational knowledge of *all* the subjects they take in (though even this I am not quite sure of ;) but such cases—happening once in some years—are out of the question when considering the thing generally. With regard to the great mass, it is notorious that they get a smattering of many things, but a thorough knowledge of only a few. I consider mechanics (including statics and dynamics) as one of the subjects the least understood; and instead of confining the examination so much, as at present, to mere algebraic details and formulæ, I would give a much larger proportion of such questions as the following:

"In finding the length of the inchronous simple pendulum corresponding to a given compound pendulum, what influence has the *density* of the material? For instance, would a wooden pendulum of any shape vibrate in the same time as a metal pendulum of exactly the same dimensions? The effect of temperature not being here considered."

Or, as another specimen:

"A table being supported on four legs, the pressure on each is said to be *indeterminate*; or, in a body revolving round a fixed axis, the pressure on the axis in its own direction is similarly said to be indeterminate: is this indeterminateness a physical fact, or merely mathematical?"

Such questions would test how far the student had really *thought out* the thing for himself, and how far he had taken the process on trust from the book: and one such question, well answered, I would make to "pay" better than twenty mere algebra things.

Now, of course, to answer such questions, it would be requisite that a very different style of books should be introduced to those now in use.

But, to return from this digression, into which I had no intention of entering, I think that such an introduction to the study of mechanics as I have mentioned, would be made highly interesting and useful, not only

to those who are about to begin mechanics itself, but to all who are engaged in the study of physics, inasmuch as the same *principles* lie at the root of all, and must be thoroughly understood in their widest generality before any really philosophical view can be taken of any one branch. That Dr. Whewell has not taken this enlarged view of the subject himself, is much to be regretted; for his admirable command of language, and extended acquaintance with various departments of science, would have given full effect to the reasoning, and forced it upon the consideration of many, whom a dry and dull disquisition by a mere mathematician, would never read at all. As it is, however, there is no work calculated to convey sound notions of the general principles by which physical effects are subjected to calculation, to any but mathematicians. With regard to mechanics itself, the extended and comprehensive view of this subject would embrace what are usually termed the parallelogram of forces and the composition of motion (or the "parallelogram of velocities," as it is sometimes called) in the same fundamental idea. The separation of these two things—which are in reality but one—is justly censured by Lagrange, as depriving them of their "evidence and simplicity." As to the lever, Dr. Whewell may rest assured—if not convinced already by experience—that, in spite of his fine writing, and Archimedes to boot, the rank nonsense of founding the science of mechanics on it, will not be tolerated in the present day, and that he is only foolishly damaging the sale of his books and his own reputation by so obstinately persisting in it.

A. H.

MECHANICS OF VEGETATION — GROWTH OF PLANTS.

Sir,—The growth of plants is an operation so essentially mechanical, that an essay thereon will not, I trust, be deemed out of place in the *Mechanics' Magazine*.

This paper treats principally on the rise of the sap in plants; the expansion and elongation of their roots, trunk, and branches; the germination of seeds, and the consolidation and conversion of the sap into the substance of the plant.

Plants, both in air and in water, rise, or are forced upwards, and their roots and branches are ramified and elongated, by the pressure of the element in which they grow; for the contractions of the plant, which also contribute to its growth, originate in the pressure of the fluid in which it grows.

The pressure of the atmosphere diminishes from its base, the earth, to its surface; and in like manner the pressure of the ocean diminishes from its bed to its surface.

The pressure of the atmosphere on all objects on the earth, at the level of the sea, exceeds 14 lbs. on each square inch of surface; and, as before observed, this pressure gradually diminishes with the distance from the earth. The pressure of the ocean on things immersed in it is still greater, and is regulated by a like gradation.

So that the pressure of the air, or water, in which a plant grows, is greatest on the roots and on that part of the trunk which is nearest to the ground, and gradually diminishes upwards. It is this arrangement of those elements which not only permits plants to rise, but which gives to them a general tendency upwards; the resistance in that direction being least, and gradually diminishing as the plant rises. It is this structure of those elements which enables, or rather causes, some substances, when immersed in them, to rise to or towards the surface,—as a piece of wood in water, or a balloon in the atmosphere.

The entrance of the sap into the roots of plants is effected by the action of solar light and the atmosphere; for solar light is air in a state of radiation, as is shown by the experiments referred to in the Note A: these agents fill the roots, trunk, and branches of the tree with air, which expands them, and opens the texture of the roots so as to admit the mixture of aqueous and earthy matter, which forms the sap; and which is then forced into them, as into a part-formed vacuum, by the pressure of the atmosphere; which, be it remembered, is greatest on the roots, and gradually diminishes upwards. And by the same pressure the sap is forced up through the trunk and branches to their extremities, and into the buds, leaves, flowers, and fruits. And when the action of the solar rays is interrupted by the intervention of clouds or the setting of the sun, the expansion of the plant ceases, and the pressure of the atmosphere acts upon it without resistance, and with such energy as to cause contraction of the roots, trunk, and branches; which contractions, in connection with the atmospheric pressure, effects a lodgment

of sap between the bark and the wood of the tree, whereby the trunk is enlarged laterally, and its girth and diameter increased; and they force that portion of the sap through the bark, which forms buds; and they also force back the sap in the roots, which elongates and ramifies them.

In the motions of the sap, however, there seems to be nothing resembling the circulation of the blood in animate bodies, or a circulation of any kind. The sap rises gradually from the roots, through the trunk and branches, into the buds, leaves, and fruit. No part of it ever returns or recedes in its passage, except the sap in the roots; which, when the contractions of the plant take place, is thereby forced back in its channels to the extremities of the roots, and through the bark or skin, and so the roots are elongated and ramified.

And the experiments mentioned in Note A, not only show that solar light, when in a quiescent state, is air, but they also show how it enters plants and expands them, and becomes an agent in their growth in water. Those experiments also show how solar light enters plants growing in air in the atmosphere: and the great pressure and extreme subtilty of the atmosphere enable it to penetrate plants with the light, and so to aid its action in their growth. Hence, we have the reason why the growth of plants in water is less vigorous than in air.

The agents which expand the roots, trunk, and branches of the tree, and cause the sap to enter and ascend, also expand seeds in the earth and cause them to germinate; the path, or way of the germ, out of the seed, being in most, if not in all cases, the way or passage into the seed, by which the sap entered which nourished and produced the seed. And it seems that the germ of the seed is partly or wholly formed by the growth which produced the seed, and its way out of the seed is previously prepared for it in the manner before mentioned; for the channels through which the sap passes admit its passage either way, provided it ascends. For instance, if in February or March, when the sap is ascending, a branch be cut from a willow, or almost any other tree, and planted with the cut end up, the bud end being in the ground, the buds which are in the ground will put forth roots instead of the leaves which they would have put forth if the branch had remained on the tree on which it grew; the sap will ascend the branch in the opposite direction to that by which it entered it when on the tree, and the other buds on the branch which are out of the ground will put forth leaves and branches. It also appears that the germ of the seed becomes the root of the plant, and the remaining substance of the seed forms the first leaves.

The sap or matter which ultimately constitutes the wood, leaves, flowers, and fruit of the tree, ascends the trunk and branches in a liquid state. It is, however, a mixture of earthy matter and water, which, after passing through appropriate channels, is formed into the wood, leaves, flowers, and fruit of the tree by the atmospheric pressure and contractions of the plant above mentioned; and being so formed, it is consolidated and hardened by evaporation (Note B) caused by the joint action of the solar light and the atmosphere. And when the sap ceases to rise in the plant with force sufficient to reach the leaves, the evaporation dries them; and the contraction resulting from the desiccation separates them from the tree, and with few exceptions they fall off. This takes place in autumn, when the diminished action of the sun's rays has ceased to expand the plant sufficiently to allow the sap to rise in force and quantity enough to supply the leaves.

The fruit of trees seems to derive both its colour and flavour from the atmosphere and solar light.

I am, Sir, yours, &c.,

G. Woodhead.

Old Hall, January 20, 1848.

Note A.—Light may be caught and examined, when it is found to be air. Thus if a burning light from a lens of five or six inches diameter be thrown upon black sealing-wax, immersed in cold water, the light enters the wax and issues out again in globules of air, which arise from the parts touched by the focus, accompanied by a crackling noise, caused by the bursting forth of the fluid; and by the operation of the light deep pits are made in the wax. If such a light be thrown upon a piece of stone, wood, rusty iron, black flint, black cloth, or any dark substance so immersed, globules of air in abundance will arise from the parts touched by the focus. If a piece

of mould candle be used, it shows how the air diffuses itself in the substance; and in all these cases, the path or passage of the light from the lens, through the water, to the object on which it acts is visible. This is the commencement of the process of burning; which, when exposed to the action of the atmosphere, that element completes. These experiments show the effect produced by light upon substances in water: its effect on substances in other liquids is worthy of trial. That the globules in all these cases are air, may easily be ascertained in the following manner:—Take a glass shade, such as is commonly used for covering artificial flowers, four or five inches deep, and three or four inches across at the mouth; immerse it in a vessel of clear cold water, and turn the mouth downward, taking care to turn the glass under water, so as to keep out the air, and leave the glass wholly occupied by the water; then put the wax or other substance to be operated on under, and leave it inside the glass, and apply the focus of the lens to it; and as the globules of air arise from the substance, they are stopped and retained by the shade. With this apparatus I have obtained air globules in abundance from sealing-wax, rusty iron, wood, brown cloth, and black flint; from lead and white pebbles a few minute globules; but from gold, silver, and glass, no air globules can be obtained with a lens of five inches diameter; because the gold and silver reflect a large portion of the light thrown upon them, and the glass transmits it, or rather it passes through the glass. With a more powerful lens I think air would be obtained from gold and silver, and perhaps from transparent substances, for they arrest and retain a portion of the light which penetrates them. The air obtained is permanent: it may be retained for any length of time. In some of these experiments part of the water was poured out of the vessel containing the apparatus, so as to lay bare the top of the glass shade; the light had then only to pass through the glass, and the water under it, to the object, which was elevated or depressed at pleasure, and the more the object was raised towards the surface of the water, the greater was the effect produced by the focus. The effect is the same whether the water has been previously boiled or not, but it is somewhat less in sea water than in fresh water.

This is not air liberated from the substances by the action of the light; because air, without diminution, may be obtained from the same substance so long as there is light enough to make a strong focus. Nor is it air from the water; for it evidently issues out of the substances. And if it were from the water, it would come from the gold and silver as well as from the iron and wax. It is from the light. These facts show that solar light is air in a state of radiation; that is, air issuing in rays or streams from a common source, as from the sun, or from a jet of burning gas. They also show with what facility air in that state of action passes through transparent substances, and how it penetrates and is arrested by opaque ones. These conclusions inevitably result from the preceding facts: it seems impossible to resist them. Those facts also illustrate the effects of the burning glass operating on substances in air. They make it evident that the light penetrates the substances and makes way for the air to enter them.

Note B.—The sense in which the word "evaporation" is used in this paper should here be stated. It is used to signify the issuing of air out of any substance animate, organic, solid, or liquid, which brings with it a portion of the liquid matter contained in the mass out of which it issues; for all evaporation is effected by the issuing of air out of other substances into which it has previously entered, either by radiation or by pressure from accession, which is called conduction. It will therefore be perceived that this definition comprehends the insensible perspiration of animate bodies, as well as the exhalations of trees and plants, and the vapour of liquids; for all vaporous exhalations are effected by the issuing of air out of solids or liquids, which brings with it a portion of the moisture contained in them. By a law of nature, which is the obvious result of the arrangement of matter, air in liquids assumes a globular form; and, when it emerges, it always comes out enveloped in a film of the liquid from which it emerges; and whenever air issues from moist substances, it brings with it a film of the moisture therein.

Thus it is that it evaporates liquids, and desiccates, consolidates, and hardens moist substances; such as clay when formed into bricks; the sap in the trunk, fruit, leaves, and flowers of trees; and the liquid gum of trees, which it converts into hard and solid lumps. It seems to be an operation of air similar to this which causes all ossifications, and the petrefaction and concretion of rocks and stones. If on a bright summer's day, when the earth's evaporation is most vigorous, a sunbeam entering your room about noon be caught on a white, or light-coloured piece of paper, the shadow of an ascending vapour will appear on the paper, though the action in the atmosphere cannot be discerned by the eye, or be detected by any other means with which I am

acquainted. At those times the atmosphere must, to some extent, be in an ascending and descending state; for the space in the earth, which the ascending matter has left vacant, will instantly be occupied by the atmosphere above it.

HENSMAN'S IMPROVEMENTS IN THRASHING MACHINES.

[Patent dated July 17, 1847. Specification enrolled January 17, 1848.]

The patentee's first improvement in thrashing machines relates to those parts which in the first instance disengage the grain from the straw; namely, the beaters and the breast of the machine, which parts he constructs in the following manner:—Upon the revolving cylinder or drum, to which the beaters are generally attached, he fixes several projecting arms. Connected to the outer ends of each pair of these arms, there is bolted a longitudinal bar running parallel with the axis of the cylinder. The outer edges of the whole of these parallel bars are cut of a serrated or toothed form. To the breast of the machine there are affixed several similar bars serrated on the edges next to the revolving cylinder, and they are placed in such a position that the projections upon them fall opposite to, or within the spaces of those on the revolving drum.

A second improvement has for its object a better adjustment of the breast of the machine in reference to the revolving cylinder. The lower side of the breast is centred upon two pins, so that it turns as upon a hinge at bottom, and the upper part is acted upon by a screw, so that it may be brought nearer to, or pushed further from the revolving cylinder, as may be required.

A third improvement consists in coupling the shaft of the machine with the shaft of the horse power which puts it in motion, in such manner that the connection between those two shafts may be permanently maintained so far as that revolution is concerned and yet admit of some degree of variation in the distances between the two machines. This is effected as follows:—On the end of the one shaft there is formed a hollow recess, with a square aperture in it, into which a square of some length, attached to the end of the other shaft, is slipped; whereby the two shafts are coupled, and continued so, although the square in the last-named shaft should be pushed further into or drawn further out of the hollow recess.

[The first of these "improvements" seems to us to resolve itself into a very clumsy imitation of the well-known peg machine of Atkinson, and to have for its object rather the evasion of that patentee's rights than any real improvement of the machine. The second and third improvements may be worth something, but will not of themselves enable the present patentee to ride over the prior inventor of the main thing.—ED. M. M.]

THE LIGHTHOUSE SYSTEM—MR. GORDON'S IMPROVEMENTS.*

The facts on which a reform of the Lighthouse system, or rather systems, of the United Kingdom, (for each of the three kingdoms has its separate and independent board of management,) is imperatively called for, have been for many years before the public; yet, still, nothing is done. The English Trinity Board totters on, as of old; the Irish Ballast Commissioners blunder on, as of old—*et more Hibernicæ;* and the "Northern Lights" are as fitful and evanescent as ever. Want of organization, want of skill, want of science, want of intelligence; caprice, ignorance, extravagance, waste, and general inefficiency; are still, as ever, painfully manifest. The sovereign cure for all these evils—a Central Board which shall absorb the functions of all the other boards, and be composed only of men of scientific or engineering eminence—is yet, to all appearance, no nearer of accomplishment than it was twenty years ago.

Mr. Alexander Gordon, who has established a high claim to regard in all matters of this sort, by the cast-iron lighthouses he has erected at Point Morant (Jamaica), Gibb's Hill (Bermuda,) Point de Galle (Ceylon,) and other places in the colonies—lighthouses unrivalled for their cheapness, and yet as efficient as any, either at home or abroad—made a strong representation some time ago to Government, of the injury which is more especially inflicted on our colonies, by our present divided and defective lighthouse system. The Trinity Board takes charge of but two lighthouses beyond our own shores, Gibraltar and Heligoland, and the Irish and

* LIGHTHOUSES; or, the British Colonies and Possessions Abroad. Being a Letter to Joseph Hume, Esq., M.P. By Alexander Gordon, M. Inst. C. E., Engineer of the Jamaica Pont de Galle, Bermuda, and other Colonial Lighthouses. 46 pp, 8vo., with two plates.

Scotch boards of none at all. The Government replied, that they would "gladly learn that the supervision" (of the colonial lighthouses) "*could* be undertaken by the board." Not denying the necessity of the thing, they yet wait to "learn" of others how it is to be brought about. What pitiable weakness! "God forbid!" rejoined Mr. Gordon, "that the Trinity Board should undertake anything of the kind. If you will not abolish all the three boards—if you will not give us a Central Board to take charge of the whole of the lighthouses of the empire—do not, at all events, hand the colonies over to that antiquated, decrepid, and incapable body, the Trinity Board. If multiplicity of boards is still to be the rule, let the Colonies have at least a board of their own. If not in the aggregate of as much importance as England, they do not certainly yield in that respect to either Ireland or Scotland."

To enforce this view of the subject, Mr. Gordon has written the pamphlet-letter which is now before us. It is addressed to Mr. Hume, who was the Chairman of the Lighthouse Committee of the House of Commons of 1845;* and of whom we are glad to learn from Mr. Gordon that he is resolved "not to cease his efforts whilst he has a seat in Parliament until the present most imperfect systems are changed." The author supports the position he has taken up with great ability and a most uncompromising boldness. We should wander somewhat out of our province were we to follow him through all the instances he adduces of the special inefficiency of the Trinity Board; but there is one which is so entirely of a scientific character as to justify our bringing it very fully before our readers:

"The lighthouse improvements, which your honourable Committee noticed favourably by their Report (in 1845), were made and introduced by me without consultation, advice, help, or even encouragement from the Trinity Corporation. I have offered several improvements for their adoption, and have been put to great personal expense in doing so without success. It was easy to stand and to understand their non-approval; but I cannot quietly let them deprive me of credit when it is due, as appears to have been attempted by their Secretary in the matter of catadioptric lights. I can show, most clearly, that the introduction in these kingdoms of the dioptric system by means of refracting polyzonal lenses, and also of the catadioptric system by means of reflecting lenses, was due to me, in conjunction with M. Maritz, of the Hague. We did not introduce the apparatus as an experiment, but as a perfect sample of light-directing apparatus, extensively used in Holland and in France, which, or some modifications of which, I proposed and published for harbour lights.* I am not yet much in favour of the system for great sea lights in the colonies, though I do propose to avail myself of refracting glass zones, in combination with silvered paraboloidal reflecting surfaces, in some important situations, especially for revolving lights.

"I recently made for the Trinity House an experimental apparatus of the latter kind just referred to, and capable of considerable variation, as circumstances may require; but upon delivery of it, lighted, at the Trinity House, it met with the same sort of official reception as my introduction of polyzonal lenses had been formerly treated in the same quarter. It was lighted with its single Argand burner (in a room where two other Argand burners and a large Fresnel lamp, fully lighted, were burning together, and, at the same time, consuming sixteen times the quantity of oil), and it was declared by one gentleman present to be no improvement.

"It is not out of place here to state, that Mr. Maritz's brother and I lighted the catadioptric system at the Trinity Lighthouse at Purfleet, with a single Argand lamp, to show how it could light the 360° of the circle. The elder brothers, or some one of them, had it condemned, because from the same size and sort of lamp a parabolic reflector could light $\frac{1}{16}$th part of the same circle better!

"The features of these two cases being much the same, the results, I expect, will be similar: indeed, I have no doubt the Trinity House will ultimately introduce my new combination, or a modification of it.

"Anticipating little *official* approbation (the italics are expressive) in that quarter, I had taken care to secure the opinions of numerous gentlemen of science before jeopardising my apparatus at Tower-hill."

We have had the pleasure of personally inspecting the "experimental apparatus" here referred to as exhibited to, but slighted

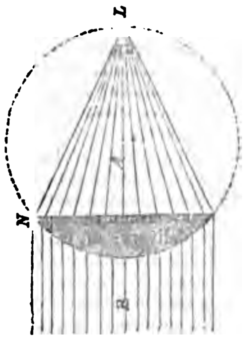
* For some material portions of this report, see *Mech. Mag.*, vol. xliii., p. 440.

* I exhibited the same at the British Association in 1834. See their Report.

for the moment, by the board of elderly gentlemen who sit on Tower-hill; and are thus enabled to give a somewhat fuller account of it than that which is contained in the pamphlet.

The property which a glass retracting lens possesses of retracting and rectilinealizing (so to speak) the radiating light of a lamp has long been well known. It is represented in the subjoined figure, in which L indicates the centre of the light; N the lens; A the radiated light; and B the refracted light.

Fig. 1.



It was not, however, till about 1797 that refractors were generally substituted in English lighthouses for mere reflectors. They were generally made of five inches in thickness and twenty inches in diameter, with a focal point of nineteen inches. The celebrated Buffon proposed to reduce the refractor in thickness and to cut the lens into steps, (as shown in plan and section in the diagrams, figs. 2 and 3,) in order that it might absorb less light.

Buffon, however, fancied that this shape could be given to the lens by *casting*; but neither at the time he flourished, nor at the present time, is this a possible operation. In 1811, it occurred to Sir David Brewster that such a lens might nevertheless be constructed by *building* separate pieces of glass together. In 1819, the distinguished French optician, Fresnel, showed not only that the generating sections of the rings ought to have the same centre, but that the different centres should be situated on the same axis of the lens. A few years later M. Fresnel

Fig. 2.

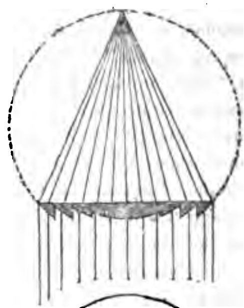
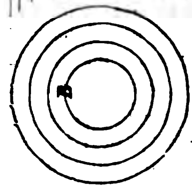


Fig. 3.



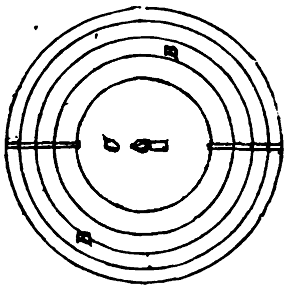
engaged M. Soliel to construct eight such lenses for the lighthouse of Corduan. In 1827, the Trinity Board witnessed some experiments with a lens of the kind represented in figs. 2 and 3, which had been *built* by Mr. Gilbert, under the direction of Sir David Brewster. In 1828, the board imported a lens of the same kind from France. In 1833, Mr. Gordon introduced the polyzonal arrangement, (both reflecting and refracting,) to which he refers in the extract we have made from his pamphlet, as having been constructed in glass by M. Maritz, of the Hague. And subsequently the Trinity Board, as also the Commissioners of Northern Lights, (at the instance of Mr. Allan Stevenson,) adopted the same system extensively.

The improved arrangement which Mr. Gordon last exhibited to the Trinity House is represented in figs. 4 and 5.

Mr. Gordon here makes use of a parabolic reflector (R), because of the property which a hollow paraboloid possesses of reflecting all light radiating from its focus (D) in straight lines (C); combined with a plain refracting lens surrounded by four refracting circles or zones, cut away into steps as recommended by Buffon, and built together on the plan of Brewster. By this

Fig. 4.

Fig. 5.



novel and happily-imagined combination, Mr. Gordon is enabled to throw into one beam nearly the whole of the available light of the lamp.

For revolving lights, Mr. Gordon proposes to use one or more such combinations or systems—each furnished with an Argand burner, or one or more revolving pieces according to the size of the beam required. For fixed lights he contemplates using as many as will light the circle of 360°, or any required portions of the circle; twenty-four systems, each with its own lamp, for the whole circle, and twelve systems for half the circle, and so on—one system to 15°.

ON THE APPROXIMATE RECTIFICATION OF THE CIRCLE.*

Sir,—At page 407 of your last (47th) volume there occurs in Mr. Dredge's paper a diagram, to which I shall refer in the following construction:

Let ABCD be a circle of which O is the centre and AC a diameter; let the chord $Aa = \frac{1}{5}$ OA and draw ab perpendicular to AC:*

In AC produced take $CA' = CA$; from C towards O set off $Cb' = 2Aa$, and from A′ draw A′E equal and perpendicular to A′A; join b'E and from E perpendicular to b'E draw EF equal to Ob': then, if, in OA′ produced, we take $b'H = b'F$, bH will equal the circumference ABCD very nearly.† For, $bH = bb' + b'H$,

$$\text{and } bb' = AO + Ob' - Ab;$$

$$\text{let } AC = 10, \text{ then } AO = 5,\ Ob' = 3,$$

$$\text{and } Hb = \frac{(Aa)^2}{AC} = .1;$$

$$\text{hence } bb' = 7{\cdot}9;$$

again,

$$b'H = \sqrt{A'E^2 + A'b'^2 + EF^2}$$

$$= \sqrt{20^2 + 12^2 + 3^2}$$

$$= \sqrt{553} = 23.515952..$$

and consequently,

$$bH = 31.4159 \text{ \&c.}$$

I am, Sir, yours, &c.,
JAMES COCKLE.

2, Church-yard Court, Temple,
January 21, 1848.

PERLBACH'S PATENT PROCESS OF UNITING WROUGHT IRON AND CAST IRON, ETC.

[Patent dated January 23, 1847. Specification enrolled January 23, 1848.]

The nature or object of this invention is said to consist in an improved method or methods of securely uniting certain metals and alloys of metals of different properties and values together; as, for example, wrought iron with cast iron, or copper with cast iron, or gun-metal with cast iron, whereby compound pieces of metal suitable for beams, girders, ribs, gudgeons, railway chairs, wheels, axles, and other parts of machinery and mechanical structures, may be produced, possessing all the aggregate weight and cohesiveness required, but much harder and stronger in some parts (such, for example, as those exposed to friction or to direct strain,) than in other parts.

Of the great utility of such a process as this there can be no question. We

* On this subject see *Mech. Mag.* vol. xlvi., p. 324, the places there referred to, &c.

* Thus far is clear from the diagram. The reader must figure for himself the remainder of the construction.

† I suggested this construction at page 116 of vol. xlv. of this work.

have seen some specimens of wrought and cast iron thus combined together which resisted every attempt of a powerful hammer to separate them. The following are the details of the process:

"*To unite cast iron with wrought iron*, as, for example, to make a rectangular beam which shall consist of one-quarter of its thickness of wrought iron, and three-quarters of cast iron, or of these two metals in any other given proportions, I proceed as follows:—I take a piece of wrought iron of the quarter, or other required thickness aforesaid, and immerse it in a cleansing bath of nitric, or any other suitable acid, diluted with water. I next remove it from the bath and make it red hot, whereupon I plunge it once more into the cleansing bath. By these processes it is freed from any oxide which may have formed upon it. Then, in order to get rid of the acid which may be adhering to it, I wash it with an alkaline solution, (sal-ammoniac for example, diluted in water,) immediately after which I immerse it in a bath of melted tin, and leave it there till it is well tinned over. I next coat or cover the tinned wrought iron on that side where it is to be united to the cast iron with an alloy or solder, composed of copper and tin in the proportion of about 5 parts of copper to 95 parts of tin. The wrought iron thus prepared is then dropped into the bottom of a mould of a size and form corresponding with that of the compound beam desired to be produced, and made fast by well-tinned pins and nails; iron, in a hot and fluid state, is next poured upon the wrought iron till the mould is filled, when a fusion takes place between the surfaces of the wrought iron and cast iron, through the action of the interposed alloy, or solder, of copper and tin, and the two principal substances become so firmly united together as not to be easily detachable, if at all.

"*To unite steel with cast iron*, I adopt the same method in all respects as has been just directed to be followed in regard to wrought iron and cast iron.

"*To unite copper with cast iron*, or *gun-metal, and cast iron*, or *brass and cast iron*, or any other of the alloys of copper with cast iron, I also make use of similar means to the preceding, only, instead of freeing the surfaces of the metal to which the cast iron is to be added by acid and alkaline solutions and heating as aforesaid, I effect this by filing merely, and add the iron at a lower degree of heat, so that it may not melt the body of the copper, gun-metal, brass, or other alloy.

"The proportions before directed to be observed in the composition of the alloy or solder, are such as will be suitable to be observed when the compound piece of metal is of a medium size; but when it is above that size, and according to the ratio in which it exceeds it, the quantity of copper used in the alloy should be increased. In the exemplifications before given the different metals have been supposed to be united laterally, or side to side, but one metal may have another united to it on both sides, or be enclosed by it on all sides, and the pieces may be also of any curvilineal, angular, or other form; the mode of casting being varied to suit the circumstances of such case, according to the practices in common use among founders."

THE STEAM SHIP "DISPATCH."—ANNULAR ENGINES.

The New South-Western Steam-Packet Company have added to their fast-increasing fleet of steamers a new one, named as above, which made her first experimental trip down the river on Saturday last (22nd instant). Her performance on the occasion justified the name which has been given to her. Her average speed in going as far as Sea Reach and back was not less than 18 statute miles per hour through the water. The engines are of 200-horses power, and built by Messrs. Maudslay, Sons, and Field, on the well-known annular principle first introduced by that eminent firm, and which, notwithstanding the many doubts that have been cast upon it, and even fierce attacks of which it has been the object, seems to increase in favour with every new trial made of it. For ourselves, we have never entertained or expressed but a favourable opinion of the principle, and now that its merits have been tested by several years practice in steamers of all descriptions, we see less reason than ever for taking part with its assailants. The great objection originally taken to engines on this plan, was the excessive friction to which it was supposed the pistons must be subject; some went so far as to say that it would even swallow up the whole power of the engines!

Now the result of all the inquiries—not a few—which we have made on this head,—inquiries not confined to those who have had the designing and superintending of such engines, but extended to the engineers who have been entrusted with the actual working of them, and have, therefore, had the best opportunities of testing and measuring the amount of friction of the piston of the annular engine, as compared with that of the piston of the common cylinder engine—is this, that though there is indeed an increase of friction in the former, it is so trifling in amount that it may be altogether neglected as an element in calculating the power of such engines, and is far more than counterbalanced by other advantages belonging almost exclusively to this and the double cylinder engines manufactured by the same firm. The advantages to which we allude are consequent upon the great length of connecting-rod of which the annular engine admits. True it is, that Mr. John Seaward and Professor Airey have demonstrated that it is a matter of indifference whether a short or a long connecting-rod is used (within certain definite limits of course) for transmitting the power from the piston to the crank; but there are other circumstances to be taken into account, than the mere lines traced out by the crank and the connecting-rod during a complete revolution of the crank. The parallelism of the piston-rod, in its upward and downward course, must in any case be maintained; but when the connecting-rod is short, the brasses of the parallel guides become much sooner worn out than when it is long. Again; in all engines, especially those of great power, the shorter the connecting-rod is, the farther the strain upon the framing (resulting from the constant change in the line of motion) is removed from the perpendicular to the horizontal line, and consequently the greater the tendency to twist the framing from side to side. The annular and double cylinder engines are excellent exemplifications of the advantage gained in this particular by the use of a long connecting-rod in preference to a short one. Not a single diagonal brace or stay is required to counteract the twisting tendency to which we have alluded, while in engines having short connecting-rods, the working parts are necessarily almost buried in cross-stays and diagonal braces, in order to protect them from being shaken to pieces.

LAUNCH OF THE LLEWELLYN POST-OFFICE STEAM-PACKET.

On Saturday, the 23rd inst., another vessel, called the *Llewellyn*, designed for the Post-office service between Holyhead and Dublin, was launched from the building-yard and steam-engine manufactory of Messrs. Miller, Ravenhill, and Co. She is 190 feet in length; of 26 feet 7 inches beam; and 643 tons burthen. The engines, which remain still to be fitted to her, will be of 350 horses-power. The vessel has a very handsome appearance, and we have no doubt we shall be able to give a good account of her as soon as her "steam is up."

RECENT AMERICAN PATENTS.

(Selected from the *Eureka*.)

IMPROVEMENT IN CHRONOMETRIC LOCKS. *John Y. Savage.*

The patentee says, "What I claim therein as new is the manner of securing the doors of bank vaults, safes, and other structures of a like character, by placing within such structure a time-piece, which may be so set as to cause the bolt or bar by which the door is fastened to slide back; that is to say, by the action of the lever or arm, the roller, the pulley and weight, and the crank-pin, operating on the bolt, as set forth; the whole combination and arrangement being substantially the same with that herein fully made known, together with such variation in the form or connection of the respective parts as may be made therein without altering the principle of action, producing the like result by means substantially the same."

IMPROVEMENT IN JOINTED PIPES FOR STEAM, &c. *Lewis Kirk.*

The patentee says,—"I do not claim as my invention simply connecting the boiler and engine of a locomotive, which are placed on separate carriages by means of a pipe made in two parts and connected by turning and sliding joints, as this has been essayed; but what I do claim as my invention, is connecting the main pipe at each end by means of two branches on opposite sides, when this is combined with the sliding joint in the main pipe, substantially as described, whereby the connections of the main pipe with the vertical pipes, and the vertical pipes with the boiler and engine, or other vessels to be connected, are sustained against any tendency to strain or break, and the openings or passages are retained of the same required size at all times, while the two bodies thus connected are free to vibrate in all directions, without interrupting the flow through the pipe, as described."

IMPROVEMENT IN MACHINERY FOR THE MANUFACTURE OF WIRE ROPE. *Edward S. Townsend.*

The patentee says,—"What I claim as

my invention, is making wire cord or rope by arranging the bobbins, with wire on radial arms projecting at a suitable angle from a disc at right angles to the axis of the main shaft, by which the wire is fed and allowed one twist to every revolution of the main shaft between the bobbins and the tubing rollers, and thus obviating the complicated gearing which would give the bobbins another revolution contrary to the motion of the main shaft, to avoid any twist in the single wires, obtaining a greater speed and economy in manufacture, and preserving in the wire the turn which, bending the wires, retains such a power as detects those splits and blisters, or otherwise imperceptible defects in the wire, which would injure the cord, and thus doing this at such a time as is most convenient to mend them and make a more perfect and reliable article in a manner nowise injuriously affected as to the fibre of the wire; and in combination with this, that arrangement of tubing rollers, suitably weighted, which holds the cord as the wires are passing round in forming, keeping back the wild turn from the cord and yet allowing the increased size of wires, from splicing or soldering, to pass the grooves by the yielding of the lever and weight; and in combination with these, the tubing rollers suitably weighted which bears upon the cord as it passes round the drum geared to haul off the cord, so as to cause greater adhesion between the drum and cord, giving greater uniformity in the lay of the twist in the cord and rounding it as it passes to the reel, with which it is connected with bands or belts; the whole being constructed as herein set forth." [We give this as in the original; though we cannot say that we clearly comprehend it.—Ed. M. M.]

IMPROVEMENT IN STUFFING BOXES. *Thomas W. Allen and Charles W. Noyes.*

The patentees say,—"What we claim as our invention is not the employment of metallic packing in a packing-box *generally*, but the employment of metallic packing, arranged, shaped and combined in a peculiar way, viz.: in a metallic matrix or cup, shapened and arranged so as to allow the piston rod or shaft passing through the stuffing-box liberty to vibrate laterally to a sufficient extent to meet the unavoidable irregularities of the engine to which it may be applied, and at the same time support within it conical-shaped metallic rings moving against and along the piston rod or shaft, as well as against and along its (the cup's) oblique surface, so that as the inner surface of the packing rings wears away, the rings may, by the proper application of springs or screws pressing them in the direction of the axis of the piston rod or shaft, be advanced along the conical surface of the matrix, so as to maintain a perfect contact of surface both with the piston rod or shaft, and with the matrix."

INQUIRIES AND ANSWERS TO INQUIRIES.

Test for Wax.—"Is there any means of testing the purity of white wax, when supposed to contain rosin and tallow, otherwise than by finding its specific gravity?"—*A Young Chemist.*

Rifles.—"Will any of your scientific contributors inform me, through the medium of your paper, whether a rifle gun should be bored perfectly cylindrical. It appears to me very extraordinary that this point should not be more generally understood. I have heard experienced gun-makers give diametrically opposite opinions: some saying that the bore should be a cylinder; others that the bore should be 'eased' towards the breech, more or less, according to the length and weight of metal of the gun. One of my informants said, that the reason why the bullet appeared to become easy towards the breech was, that the wadding was cut by the rifling, and consequently the ball slipped down more easily. It seems to me that wadding is of no use, inasmuch as it never holds perfect to the bottom of the barrel."—*An Old Subscriber.*

Perpetual Motion.—"B. T. C. W. I.," (Cardiff.) No reward has been offered by Government; it has done many foolish things, but none so foolish as this.—Before our correspondent wastes any more time on his scheme, let him first seat himself on a three-legged stool, and try to lift himself by the legs of the stool. If he succeed in that, he may go on—the want of Government reward notwithstanding.

Railway Bars.—The cutting of the ends of railway bars is effected by circular saws, like those used for wood, but revolving at the prodigious rate of 1000 revolutions per minute. The lower edges of the saws dip into water. The bars are brought red-hot to the saws, and both ends are cut off simultaneously in a few seconds.

French Tulip Wood.—"E. D. N." We believe this wood comes from one of our own foreign possessions (Madras); but it is not often to be met with in this country. The tulip wood in ordinary use by our Tunbridge-ware manufacturers is imported from the Brazils.

Electricity and Magnetism.—"A Constant Reader" will find all he wants in the "Manual" of Dr. Lardner and Mr. Walker (part of the "Cabinet Cyclopædia.") Mr. T. Bowles may also consult the same with advantage.

Sunderland Iron Bridge.—"E. Finnis." The celebrated Thos. Paine did propose to construct bridges of iron before Mr. Burdon; but not on the same plan as the latter, who built the bridge at Sunderland on a plan of his own, for which he took out a patent September 18th, 1795.

The Electric Telegraph.—"T. T. B.," who twits us with being misinformed respecting the adoption of Mr. Bain's system, has been misled by an erroneous account in the *Athenæum* of last week. The system, though in the course of being experimented with, has not yet been actually adopted for the transmission of intelligence from place to place. Our authority is Mr. Bain himself. We take this opportunity of correcting the statements which have been generally current respecting the high charges made by the Company. For a mes-

sage not exceeding 20 words, the charges are only as follows:—To Southampton, 5s. 6d.; Yarmouth, 7s.; Birmingham, 6s. 6d.; Manchester, 8s. 6d.; Liverpool, 8s. 6d.; Berwick, 12s.; Edinburgh, 16s.; Bristol, 13s.

Electric Telegraph Wire.—"Would not the electric current be transmitted more quickly by copper than iron wire?"—*Z.* Yes; but the difference is so inconsiderable as to be not worth taking into account; while galvanized iron wire—which is the sort used—is not only one-third cheaper, but lasts much longer, being protected by its zinc coating from corrosion.

NOTES AND NOTICES.

Royal Steam Navy.—We observe in the newspapers that Mr. E. W. Baker, one of our oldest correspondents, has been gazetted as a first-class engineer, without going through any of the subordinate grades of the service, and appointed to the steam launch of the *Meander* frigate, which is going out to Borneo with the new Raja of Sarawak. Mr. Baker is a gentleman of great practical experience in steam-engine matters, and well deserves the compliment paid to him. The launch, by the way, is *not* propelled by a screw, as stated in the newspapers, but by paddle-wheels.

The Conway Tubular Bridge.—About 200 feet out of 400 of the wooden supports to the tube have been removed, with which the tubes exhibits no sensible deflection. When they are all removed, the bridge will rest on two temporary pillars constructed under its ends, for the purpose of testing it. By this day it is expected the whole will be removed, and the invention be fully tested. After that, it will, with all expedition, be floated to the piers in the river, and raised to its proper place. If all things go on well, it is expected that the line to Bangor, 59½ miles from Chester, will be opened for goods traffic by the 1st of March.—*Chester Courant.*

New Spinning Material.—A letter from Leipsic, of the 14th, says—"The owner of some spinning-mills at Berlin has lately brought into the market a new species of flaxen thread, which is extremely long and silky, white in colour, and spun and dyed with extraordinary facility. This primary material, which possesses, even in a superior degree, all the qualities of silk, is likely to compete with it from its simple and rapid fabrication, and from its price being very low as compared with that of silk. The appearance of this new article of commerce has caused a great sensation among the dealers at the fair at Leipsic; and an Englishman has offered the inventor 20,000*l.* for his secret: but this was refused, as the owner intends to reserve to himself all the benefits of his discovery.

Galvanised Iron.—Mr. Nasmyth, of Patricroft, and Mr. Owen, two gentlemen connected with the Government Committee on the subject of metals, have lately been trying experiments, the result of which would indicate that, by giving iron a coating of zinc, or by combining zinc with iron in its manufacture, it will be much improved, preserved from oxidising, and rendered less brittle; and that old plates of iron—such, for instance, as have been used for the bottom of ships—with an admixture of zinc, still possess their original qualities; and, in fact, that iron remelted from such plates is of a better quality than at first. These experiments have attracted attention to the important question, whether iron would not be improved by a small portion of zinc? Tinned iron, exposed to the atmosphere becomes oxidised; but in iron protected by zinc, although exposed to all weathers, there is no change. Indeed, a piece made bright, remains so after being placed in water for several months. The zinced iron, which is now used in roofing large buildings—as, for instance, the new Houses of Parliament—had the quality of becoming encrusted with a coat of oxide of zinc, which prevented any further destructive effects from exposure to the atmosphere.—*Mr. Robert Hunt.*

The Origin of Meteoric Stones.—Various theories have been broached with respect to meteoric stones. Some have thought that they are projected from volcanoes on the earth with such force as to convey them through the air for a great distance, and others are of opinion, that they are projected from volcanoes in the moon. With regard to the latter it has been said, that if a body were projected at a rate equal to 6,000 miles in a second, that is, three times faster than an ordinary cannon ball—it might be thrown beyond the bounds of the moon's attraction, and brought in two days within the limits of the earth's attraction. There is, however, no evidence in support of the one theory more than the other. But there is no necessity to go either to the moon, or to the volcanoes of the earth, for a feasible theory on this subject. When it is considered that in the whole of the metals a large quantity is carried off in various chemical forms, as in vapours so attenuated as almost to set at defiance the closest experiments, and disseminated through the atmosphere, it certainly requires but little acquaintance with the wonders of chemical science, to imagine it possible, that in the upper regions of air, some electrical or other influence might bring them within the limits of cohesion, when their specific gravity would at once cause them to fall to the earth.—*Mr. R. Hunt.*

Progress of Steam Navigation in the Indian Seas.—The *Mining Journal* gives the following as a list of the steamers belonging to the Honourable East India Company:—*Acbar*, 1,143 tons, 350-horses power, 6 guns: *Ajduha*, 1,440 tons, 500-h. p., 6 guns; **Assyria*, 153 tons, 40-h. p.; *Atalanta*, 616 tons, 210-h. p., 5 guns; *Auckland*, 946 tons, 220-h. p.; *Bernice* 664 tons, 230-h. p., 3 guns; **Comet*, 204 tons, 40-h. p.; **Conqueror*, 204 tons, 40-h. p.; **Indus*, 304 tons, 60-h. p.; **Meenec*, 409 tons, 80-h. p.; **Medusa*, 432 tons, 70-h. p.; **Meteor*, 149 tons, 24-h. p.; *Moozuffer*, 1,140 tons, 500-h. p., 6 guns; **Napier*, 1,440 tons, 500-h. p., 6 guns; *Nimrod*, 153 tons, 40-h. p.; **Nitocres*, 153 tons, 40-h. p.; *Planet*, 335 tons, 60-h. p.; *Queen*, 760 tons, 220-h. p., 4 guns; **Satellite*, 335 tons, 60-h. p.; *Semiramis*, 1,000 tons, 300-h. p.; *Sesostris*, 876 tons, 220-h. p., 4 guns; *Snake*, 40 tons, 10-h. p.; *Victoria*, 714 tons, 230-h. p.; *Zenobia*, 684 tons, 280-h. p. The vessels marked * are built of iron, and were sent from England in pieces. The greater portion were constructed on the Thames and Clyde, and put together at Bombay.

Passage of the Desert.—The Pacha of Egypt is stated in the newspapers to have given orders for the immediate construction of a steam omnibus, to convey passengers and luggage between Cairo and Suez. It is to run on three wheels, to be of 200 camel power, and to be capable of conveying 100 persons. The designer is an English engineer, of the name of Maslon.

Glass Milk Pans are now coming into very general use in dairies. Milk not only remains much longer sweet in them than in either wooden or stoneware vessels, but yields more and better cream.

First Sight of a Steamer.—When a steamer was first started at Trinidad, Sir Ralph Woodford took a pleasure trip in her through some of the Bocas into the main ocean. When they were in the middle of the passage, a small privateer was seen making all sail for the shore. Her course seemed unaccountable; on nearing the coast, she ran herself directly on shore, and her crew, leaping out, scampered away over the mountains. This was so strange a sight, that, to discover the cause, Sir Ralph went on board the privateer, and found only one man there, who had been prevented run-

ning off with the rest by a broken leg. He was as pale as ashes, his teeth chattered, his hair stood on end, and to every question his only reply was—"Miséricorde! miséricorde!" It was at last extracted from him, that when the captain and crew saw a vessel steering, without a single sail, directly in the teeth of the wind, current, and tide, they concluded that it could not be propelled by any human means, but must be some demon ship in quest of victims.—*Six Months in the West Indies.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Henry Heywood, of Throssle Ness Mills, Blackburn, Lancashire, for certain improvements in looms for weaving. January 22; six months.

William Hudson, of Burnley, Lancashire, machine maker, and John Dodgson, of Burnley, same county, overlooker, for certain improvements in looms for weaving. January 22; six months.

Henry Hornblower, late of Dalgleish-place, Commercial-road, Middlesex, but now of Devon's-lane, Bromley, engineer, for certain improvements in machinery for exerting motive power, and for raising and forcing fluids. January 25; six months.

Thomas Topham, of Ripley, Derbyshire, manufacturer, for improvements in the manufacture of time-tables. January 25; six months.

George Fergusson Wilson, of Belmont, Vauxhall, gentleman, for improvements in treating and manufacturing certain fatty or oily matters, and in the manufacture of candles and night lights. January 25: six months.

Henry Highton, of Rugby, master of arts, and Edward Highton, of Regent's-park, Middlesex, for improvements in electric telegraphs. January 25; six months.

James Barr Mitchell, M.D., and Thomas Bett Woolryche, chemist, for improvements in the manufacture of soda, and in treating products obtained in such manufacture. January 26; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Jan. 22	1327	Joseph Mappin	Sheffield, and Fore-street, London	Razor.
,,	1328	Charles Jones	Windmill-street	Improved spring fastening for umbrellas and parasols.
25	1329	David Green	Cosely, near Bilston	Box smoothing iron and heater.
26	1330	John Michael Webster,	Brewer-street, Golden-square....	Walking mud protector.

Errata in Mr. Cockle's Chapters on Analytical Geometry.

CHAP. VII. Vol. xlvii. P. 434, Section 3, lines 9—10; *for* equation *read* equations. Line 11; after y add $=z$

CHAP. VIII. P. 451, col. 1, note †, line 7, *for* , *read* .; line 8 omit the stop (.); lines 7 and 8, transfer "In" from the 8th to the 7th line, and let it precede the word "the" in the 7th line. Also col. 2, line 2, *for* (*Ex.* 3.) *read* (*Ex.* 4.); line 23, *for* (*Ex.* 4.) *read* (*Ex.* 5.); line 33, after z add $=$.

CHAP. IX. In current volume, p. 82, col. 1, line 8 from the bottom, *for* "." *read* ,; and in the same page and column, line 7 from the bottom, *for* "W" *read* w.

CONTENTS OF THIS NUMBER.

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BIRAM'S IMPROVED TELL-TALE.

Fig. 1.

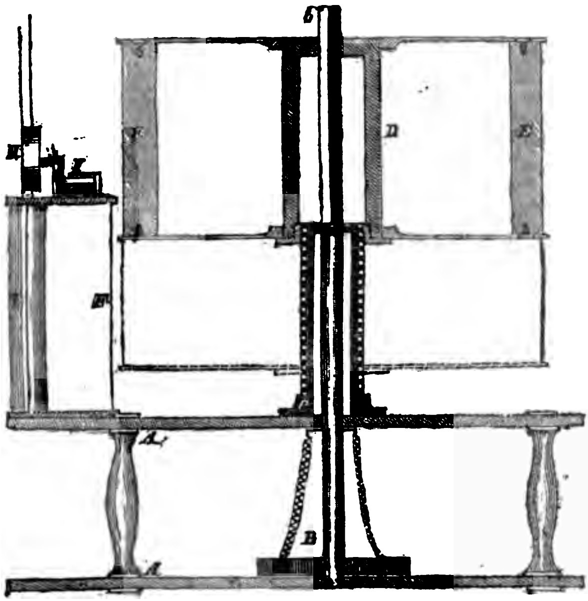
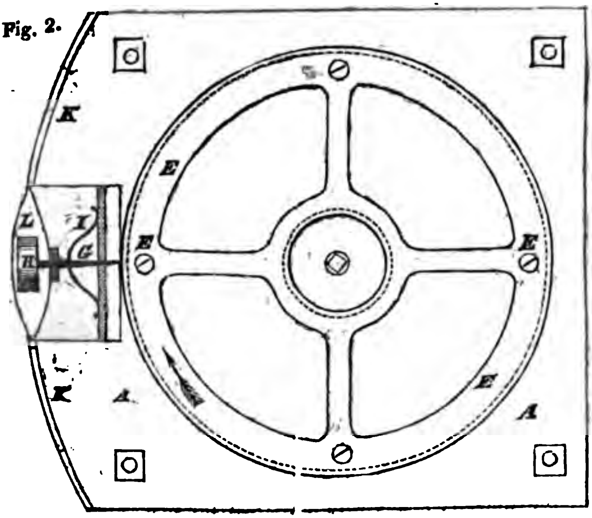


Fig. 2.



DESCRIPTION OF AN IMPROVED TELL-TALE. BY BENJAMIN BIRAM, ESQ.

Dear Sir,—The description of the "Horological Tell-tale," which appears in the 1269th Number of the Magazine, reminds me of a contrivance of my own for accomplishing the same object, which in many respects is superior, I think, to the one above referred to; but principally from registering for a week together, and from admitting of the registering paper being removed from the time-piece and preserved for any time, or removed to any distance, and recording the due attendance of a watchman or other person in a way which must be correct, and by marks that could not easily be obliterated. I enclose a description of it, in the hope that you may deem it worthy of a place in your pages; and am, dear Sir, &c.,

Benjamin Biram.

Wentworth, December 17, 1847.

Description.

Fig. 1 is a side elevation in section, and fig. 2, a plan of the apparatus (on a scale a little less than half the full size).

A A is the frame, supposed to contain the works of a portable time-piece, of which B is the fusee; C, is a hollow screw, fixed upon the frame A, through which the axle of the fusee is prolonged, being supported by, and turning in a circular opening at *a*, above which the axle is square, the diagonal of the square being equal to the diameter at "*a*;" D, is a hollow tube having a female screw fitted into the bottom, to turn easily upon the male-screw, C; the top of the tube D, has a square opening to fit easily upon the square end of the axle of the fusee; which axle should project about half an inch beyond the tube D, when in the position shown in the figure, to receive they key or handle used in winding up the time-piece; E is the barrel or cylinder round which the registering paper is placed, which should be made to fit upon the tube D, sufficiently tight to retain its position wherever placed, but capable of being easily turned round upon the tube, or slightly elevated or depressed, for the purpose of adjusting it to the index F, to show the time of the day, and also to adjust the registering lines with the pricker G. F, the index showing the time, is a fine wire placed vertically as near as possible to the cylinder, the ends being secured in a frame attached to A. The top of the frame also carries the pricker G, placed exactly over the wire F, which is acted upon, and makes an impression upon the registering paper when a finger is pressed upon the stud H; I, shows a slight spring, intended to return the pricker and stud to their position when the finger is removed; L, is a piece of glass in front of the time-piece, the horizontal section of which is that of a double convex lens, but the sides vertically are parallel with each other; this magnifies the parallel and diagonal lines upon the paper which show the minutes, *horizontally* only, showing the time more distinctly to the fraction of a minute; K K, are two pieces of plane glass, on each side of L, for the purpose of throwing more light upon the barrel.

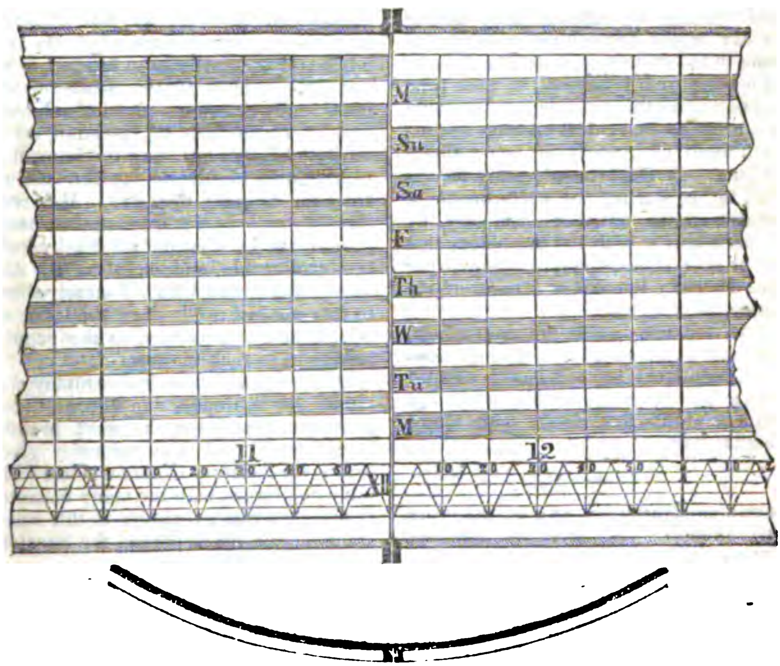
Fig. 3, shows a portion of the registering paper, of the full size, with the shaded lines upon it indicating the days of the week: this paper is of exactly the circumference of the cylinder, and is put upon a strip of leather, gutta percha or other flexible material, also of the length and width of the barrel, to each end of which is riveted a strip of brass, having a projection on each side to catch into a notch in the projecting flanches of the barrel. When the registering paper is changed, the barrel may be taken off from the tube D, and the leather and paper from the cylinder; and then a new paper put on, the ends of the paper being turned underneath the leather, and retained by any adhesive application such as that made use of in postage stamps.

The registering paper is divided vertically by twelve equidistant parallel lines representing the hours, and again subdivided between each of the above lines by other finer lines into ten minutes. On the lower edge of the paper are five parallel lines crossed by two diagonal lines between each of the above subdivision or ten minute lines, by which each subdivision is again divided into minutes, the time of the day being shown by the point when the index wire, F, intersects these small parallel and diagonal lines. The shaded lines representing the days of the week are not drawn parallel with the edge of the paper, but in such a

manner that when the paper is fixed round the barrel the shaded lines at one end of the paper fit opposite the intervals at the other end, these shaded lines and intervals being each exactly equal in width to the pitch of the screw C.

Now, suppose the time-piece newly wound up, and a new registering paper placed upon the barrel at midnight on Sunday, (of course this untimely hour is not necessary, as the operation may be done at any time of the day). The barrel will then have been removed from the position shown by the dotted lines in fig. 3, to the shaded part above in the same figure, and the pricker, G, would then be opposite the commencement of the underside of the line M, (fig. 3,) and every part of the underside of that line would by 12 at noon have passed under the point of the pricker; when the barrel having made one revolution would also have descended one thread of the screw, and during the next revolution the upper side of the line M, representing the afternoon hours of Monday, would have passed under the pricker, and so on through the week; the lower side of the line representing each day passing under the pricker during the forenoon, and the upper side on the afternoon of such day. It is

Fig. 3.



therefore obvious, that any impression made upon the paper by the pricker, would show the day and the exact time of day when such impression was made, and when the paper was removed from the barrel the punctures remaining upon it would be an enduring testimony, to be consulted and checked at leisure, of the operations recorded upon it during the week.

The uses to which this tell-tale might be applied are various. If as a watchman's clock, it may be used by several people who are required to be at a certain spot at certain or uncertain intervals. When a person presses upon the stud, he should be required to make a memorandum of the time by the clock; these memoranda he would give up to the inspector at the end of the week, who

would compare whether the punctures upon the paper corresponded with the return; and if not, the writer would of course be detected of making a false statement. In an establishment where there are a number of individuals and it is desirable to ascertain the time of their attendance, they might be required to write their names, and the time of their arriving, in a book, at the same time pressing the tell-tale; when although several might arrive and sign so near together that the punctures upon the paper might run one into another, yet the time between the first and last would be distinct, and if the names were written in succession, it would be evident that they had been written during the time between the first and last puncture. Again: any individual leaving an establishment during the day might be required to write his name in the same way, with the time of his leaving and returning, at each time pressing upon the tell-tale, which would be a great check against a person absenting himself improperly, or being absent too long. It might also readily be applied to registering the performance of a steam-engine, or other machinery, by so connecting it with the machinery that the pricker should puncture the paper after a certain number of strokes of the engine, or otherwise.

The tell-tale, as in the engravings, is shown attached to a portable timepiece, regulated by a balance escapement; but it is applicable also to a common eight-day clock, with slight modifications.

ON THE CONSTRUCTION AND VENTILATION OF SEWERS. BY WILLIAM DREDGE, ESQ., C.E.

Sir,—What a blessing it is we do not see the air we breathe! If by any chance it should become visible, not even the desire of growing rich would induce many persons to congregate together in large towns, to breathe every minute an atmosphere compared with which the November fogs of the metropolis would be clear and pleasant.

We should object to a glass of water taken from "the Thames" at London-bridge; its appearance would show it to be unfit for use, and the stomach and palate, instructed by the eye, would reject it with disgust. But if the water *appeared* clear, we should drink it; the other senses, uninfluenced by the sight, accommodating themselves to the circumstances by which they are surrounded.

The air we breathe is more impure than the river water at London-bridge, and the gases freed by the decomposition of organic matter taken into the lungs, are more injurious; having a more vital influence upon the animal functions than the solid particles of similar feculent matter received with the water into the stomach.

Not long ago there was a great agitation against the still existing "smoke nuisance." The outcry was universal, because it is a *perceptible* nuisance. It can be seen, and therefore it was inveighed against. Smoke issuing from a chimney blackens the air, but it constitutes a very small portion of the impurities that actually exist in it. I much question, indeed, if the action of the furnace, by drawing a considerable current of air towards it, does not do as much good, by ventilating the immediate neighbourhood, as the smoke issuing from the chimney does evil. However, this is no reason why the nuisance should not be abated; the black smoke is objectionable, and ought to be altogether done away with: I merely allude to this one evil to illustrate the influence which the eye exercises on the popular judgment in such matters.

Of all the agents actively employed to vitiate the atmosphere an ill-conditioned drainage is perhaps the most prolific. One cannot read the evidence given before the Sanatory Commissioners without being struck with the many instances of disease directly traceable to this cause. Dr. Baker, in his Report on the Sanatory Condition of Derby, says,—

"There are in this (the north) side of the street, 54 houses, and between October, 1837, and March, 1838, the families inhabiting six adjoining houses in the middle of the row were grievously afflicted with typhus fever, whilst those who dwelt in the remaining 48 houses were comparatively healthy; Nos. 25 to 30 were the houses so attacked." He then states that on examination, "the state of the premises belonging to these ill-fated houses was found to be as follows: There were not any sinks or drains, and the cesspools were overflowing into a ditch running at the bottom of the garden

(which was here open,) which, here and there obstructed, formed a succession of foul and stinking pools, from four to six feet wide, whilst the earth of the garden was perpetually saturated with the offensive moisture exuding from them." The other houses were all provided with drains, and the ditch at the bottom of the garden was covered over.

Of late years considerable improvements have been going on in some districts in the metropolis; but the new Commission have yet much to do to remedy the evils that have been so long suffered to exist. The egg-form of sewer and plan of flushing, first introduced by Mr. Roe in the Holborn and Finsbury division, cannot be too highly spoken of. By means of these improvements, and by joining the drains with a curve, or at a very acute angle, the discharge down the sewers is greatly facilitated, and the accumulation of filth, inseparable from the use of flat-bottomed drains, is entirely prevented.

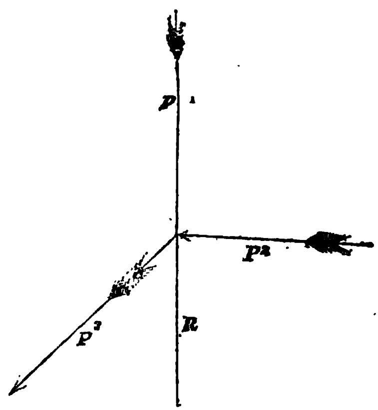
It is scarcely worth notice, though I have heard it asserted, that flushing the main, checks the flow, and therefore tends to accumulate deposit in the subsidiary drains. Nothing can be more erroneous than such a supposition, and it does not require much scientific knowledge, to show that if the subsidiary drains are laid down with a due regard to the angle of junction, flushing must facilitate rather than retard their flow. Thus let us suppose P^1, fig. 1, to represent the main sewer; P^2, the smaller one, and the

Fig. 1.

arrows the magnitude velocity and direction of the currents; then P^3, the resultant of these forces, will be the direction, magnitude, and velocity of the combined currents, which, being greater in every respect than P^2, it would facilitate its discharge.

By an examination of the diagram, it will be seen that the effect of P^2 causes a change in the direction of the water in the main drain, which, to prevent deposit, should be curved from the point of junction in the direction of the current. When the angle made by the subsidiary drain is very acute this is not of much consequence, but the evil is considerable when the junction is made at right angles. Thus, in diagram, fig. 2,

Fig. 2.



the resultant P^3, of the confluent drains, P^1 and P^2, is the direction the main drain should take from the point of junction, and not be carried on straight in the direction R. If it be, deposit will be the certain result.

The ventilation of apartments by the escape of a jet of steam, and the effect of the blast of a locomotive in increasing the draught through the fire, are practical illustrations of the principle, that the velocity of a fluid in one channel, facilitates the flow in all collateral branches communicating therewith.

The remarks which follow on trapping, subsidiary sewers, and ventilating the main sewer, are, I believe, new, and, if my reasoning on the points is correct, of importance.

The usual plan for effluvia traps is exhibited in figs. 3 and 4; fig. 3, being that applied to street drains, and fig. 4, that used for house drains. The parti-

cular form may vary from that here delineated, but the principle of sealing the discharge orifice with two or three inches of water is universally adopted. The efficient action of such trap depends upon the assumption that the atmospheric pressure per square inch on the surface, *c d*, (figs. 3 and 4,) is at all times equal to the pressure per square inch on the surface *a b*, caused by the noxious gases generated in the sewers. Now, this is an assumption which we are by no means warranted in making. My reasons for this I will illustrate by analogy. Steam is generated in a boiler by the decomposition of water caused by the action of the fire. The gases in a sewer are generated by the decomposition of the organic matter deposited therein. Both the vapour of water and the gases arising from the sewer have the same mechanical effect; that is, the steam confined in a cylinder drives the piston and gives power to the engine, and the gases similarly confined would have the same action. These gases are generated in the sewer, and in a measure confined there, and, in exerting themselves to escape, cause a pressure on *a b*, generally in excess of the atmospheric pressure on the surface *c d*.

Again: the elastic force of steam is always equal to the load on the safety-valve and the load on the engine; or, in other words, it is always exactly equal to the pressure opposed to its expansion. In like manner the chemical decomposition of organic matter gives out elastic gases, whose effort to expand is exactly equivalent to the force exerted to restrain them; which, as the force exerted to prevent the gases from annoying us, is only the hydrostatic pressure of the few inches of water with which the trap is sealed, is at most not more than 3 oz. per square inch. The trap, therefore, is in effect a mere safety-valve to the sewer, preventing the elastic pressure of the noxious gases generated in it from ever becoming more than 3 oz. in excess of the atmospheric pressure, and unless there is some mode of escape for the gases from the sewer before their elasticity equals 3 oz. per square inch, the traps must become inoperative for preventing the escape of gas.*

If steam be generated under a pressure of, say 50 lbs. per square inch, and that load be suddenly removed from off the safely-valve, a large volume of water would be instantly decomposed and flash into steam, so that its volume would be increased many times. So also, is it with the decomposition of organic matter and consequent generation of noxious gases under the ordinary atmospheric pressure of 15 lbs. per square inch. If this pressure be suddenly lessened, it follows, that the decomposition must go on to a greater extent and more gas be liberated. And we may be well assured that this is very frequently the case, for it often happens that a variation of one or more inches in the mercurial column of the barometer occurs in a few hours†—thus suddenly lessening the atmospheric pressure by nearly 1 lb. per square inch, and therefore taking that pressure from the surface, *c d*, and thereby destroying the equilibrium of the water in the trap.

It may be urged in opposition to the foregoing, that gas is supplied in towns during the day at the exceedingly low pressure of one or two inches of water, and the velocity with which it escapes would show that a pressure of 3 oz. or 5 ins. of water would be amply sufficient to retain it. The analogy, however, does not hold: first, because the gasometer is always situated at the lowest possible level in the district which it is intended to supply, and the gas rises by reason of its inferior specific gravity; and, secondly, because the flame from the burner removes in a great measure the pressure of the atmosphere and facilitates the supply from the pipes. If the works were situated on the summit level, and the gas forced downwards, a much greater pressure would be required. The like is the case with the sewers, and the high temperature which the decomposition causes increases the elasticity of the vapours which they give forth.

* I would not wish to be understood as saying that the gas, when its elasticity is 3 oz. in excess of the atmospheric pressure, would escape as freely as though no water were interposed between it and the external air. The force with which it would escape would be the excess above the hydrostatic pressure of the water. Thus, if the elastic force of the gases be 4 oz. per square inch in excess of the atmospheric pressure, and the hydrostatic pressure of the trap be 3 oz., then 4 − 3 = 1 oz. would be the force with which the gas would tend to escape.

† The barometer in the apartments of the Royal Society during twenty-three years, viz., from 1800 to 1821 inclusive, gave a mean height of 29·86. The greatest height was 28·18., and consequently the greatest range 2·59, making the mean annual range during the same period 1·92.

Fig. 3

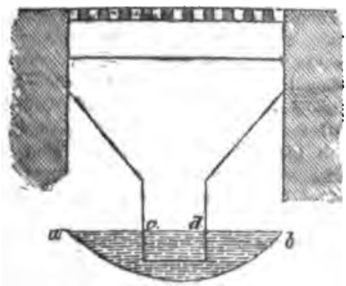
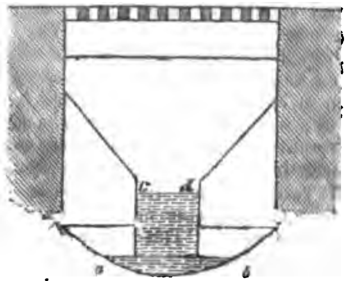
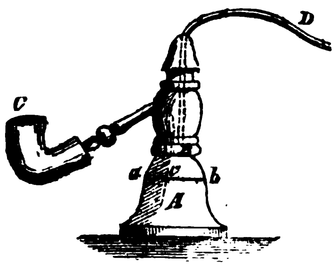


Fig. 4.



In the hooka or Turkish pipe, fig. 5, the

Fig. 5.



smoke is drawn from the bowl C, through the tube CA, discharging itself at the orifice A. As the depth, c A, below the level, $a\,b$, of the rosewater contained in the bell-shaped glass, the smoke rises to the top or vacant space above the water in the glass, and is drawn into the mouth through the tube B D; then the pipe C A is sealed similarly to the effluvia-traps in common use by the depth of water c A. Yet by reducing the pressure from the surface $a\,b$, the smoke freely passes the water in which the end A of the tube C A is immersed.

(*To be continued in our next.*)

10, Norfolk-street, Strand, Jan. 28, 1848.

RIFLES.

Sir,—In answer to the inquiries of your "Old Subscriber," whether a rifle gun should be bored perfectly cylindrical; I will endeavour to give a brief summary of the science of the question, as I agree with him, it is a subject very imperfectly understood.

Matter intended to be put into a high state of velocity as a projectile, and to have two motions given to it, one horizontal and the other spiral, and both "*coincident to its flight, or parallel to the line of direction,*" must receive these two impulses at the same instant; for it must be apparent that the spiral must be, and will be best given when the ball is receiving the motion, or, in other words, when starting from the breech of the gun. It is absurd to suppose that the spiral grooves in the barrel, by being tighter at the muzzle can cause the ball to spin on its axis, after it has received a velocity of perhaps 2,000 feet per second; for, in truth, the time during which their influence can be exerted on the ball is so short that no effect can take place.

Thus it becomes clear, that a rifle barrel if tight anywhere should be tightest at the breech: but I prefer a barrel cylindrical and slightly widened at the muzzle, to oppose as little friction as possible to the ball in leaving the tube, as practice shows us that a pebble is capable of deflecting the direction of the heaviest cannon ball at the highest velocity. Rifles in point of construction are of endless variety, and fabricated according to the fancy or limited knowledge of each mechanic: their range and accuracy are sacrificed in a number of ways, arising from ignorance of or an imperfect acquaintance with the principle of their construction. No well-made

rifle should possess the defect alluded to by your correspondent. The degree of spiral given to the grooving of a rifle-barrel should be according to the use for which it is intended. For instance, the French military rifle, whose spiral has an inclination or one complete turn in 15 feet, will range its ball 1,500 yards; while, on the contrary, the English military rifle, with one turn and a quarter in 3 feet, will not range its ball 800 yards, though in both cases the weight of projectile and the expelling force are equal. This arises from the excess of spinning motion given to the ball in the latter case, inducing a degree of friction amounting to nearly 100 per cent. during the entire range. It is a truism clearly established, that the action of the atmosphere is the greatest obstacle to a ball's flight; therefore if the periphery of a ball be required to spin five times in 4 yards, it must pass through a much greater degree of space than the axis, and hence the loss of range.

The most accurate rifle that I have ever seen was one invented by Mr. Wesson, of Northborough, Massachusetts, United States of America. It is quite practicable to hit a space 6 feet square eight times out of ten, at 900 yards distance; but here by loading at the breech the spiral motion is given at starting, and the spinning induced by a moderate degree of spiral.

There is now at Woolwich some rifle cannon of the largest calibre, of Swedish manufacture, which by loading at the breech give the spiral motion also at starting, and range the astonishing distance of three miles with wonderful accuracy.

In conclusion, I would gladly see this subject better understood; for should we unfortunately become engaged in a war, the loss we shall suffer from our brave soldiers being worse armed than those of any nation in Europe will be lamentable, for the English musket is, unfortunately, on a par with the rifle, ranging barely 850 yards, while the French is quite equal to 1,400 yards; so that it appears evident we shall have only our bull-dog courage to fall back upon.

I am, Sir, yours, &c.,

WILLIAM GREENER.

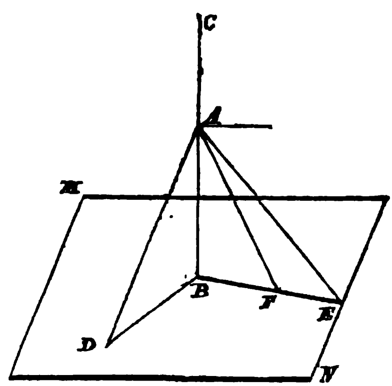
Aston New Town, Birmingham, February 2, 1848.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 526, vol. xlvii.)

PROP. XXVIII.

(1.) *Let A be a point without the plane MN: the perpendicular AB from A to MN is the shortest line that can be drawn from A to MN.*



For let AD, any other line, be drawn through A to meet the plane MN in D, and let DB be joined.

Then since AB is perpendicular to the plane MN, it is perpendicular to the line BD in that plane (*prop.* 24.). Wherefore, since ABD is a right angle, the angle ADB is less than a right angle (*Euc.* *i.* 17.); and hence AD, which is opposite to the greater angle is greater than AB which is opposite to the less (*Euc.* *i.* 18.). The perpendicular is, therefore, the shortest line that can be drawn from A to MN.

(2.) *Let BC be perpendicular to the plane MN, and from any point A in BC let lines AD, AF be drawn, making the angles BAD, BAF equal to one another: then will AD, AF be equal, and likewise DB, BF.*

For, join DB, BF. Then the angles ABD, ABF being right angles (*prop.* 24)

they are equal to one another; and BAD, BAF are equal by hypothesis, and AB common to the two triangles. Wherefore, the remaining sides of the triangles are equal each to each; viz., AD to AF and BD to BF. (*Euc. i.* 26.)

(3.) *From any point A in the perpendicular BC lines AD, AE are drawn to meet the plane MN, and the angle BAE is greater than BAD; then AE is greater AD and BE than BD.*

For, since BAE is greater than BAD, if the line AF be drawn in the plane BAE to make BAF equal to BAD, the line AF will fall between BA and AE, and will hence meet the plane MN in a point F between B and E.

Then, by the preceding case AD is equal to AF. But the angle AFE is greater than the right angle ABF (*Euc. i.* 16.); and hence greater than AEF. Wherefore, AE is greater than AF (*Euc. i.* 18.), that is than AD. The conclusion, then, follows.

Corollaries.

The converses of these properties are also true:

Lines drawn from points equidistant from the perpendicular to the same point in it are equal to one another, and make equal angles with the perpendicular, etc., etc.

From the same point in a plane let lines be drawn to different points of a line which is perpendicular to the plane: then

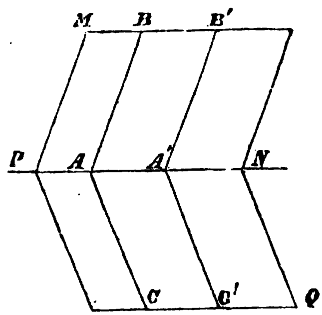
(1.) *That which makes the greater angle with the perpendicular is less than that which makes the greater angle.*

(2.) *Its intersection with the perpendicular is nearer to the plane than the other intersection is.*

(3.) *Equal straight lines AB, AD make equal angles ADB, AFE with the plane MN; and the greater line AE makes a less angle AEB than that, ADB, made by the less line AD with the plane.*

Prop. XXIX.

All the profile angles of the same dihedral angle are equal; those of two equal dihedral angles are equal; and if the profile angles of the two dihedral angles be equal, the dihedral angles are themselves equal.



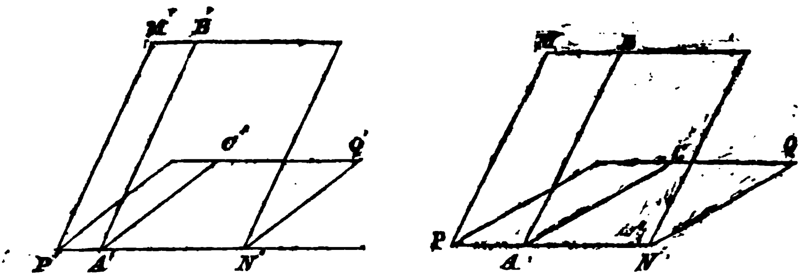
(1.) Let the planes MN, PQ, meeting in PN, form a dihedral angle; and from any two points A, A′ in PN draw the perpendiculars to PN, *viz.*, AB, A′B′ in MN and AC, A′C′ in PQ: then the profile angles BAC, B′A′C′ will be equal.

For since AB, A′B′ are perpendicular to the line PN and lie in the same plane MN, they are parallel; and for a similar reason, AC, A′C′ are parallel. Whence since the two lines BA, AC which meet in the point A, are respectively parallel to the two B′A′, A′C′ which meet in the point A′, the angles BAC, B′A′C′ are equal, (*prop.* 7.) Wherefore it follows that all the profile angles of the dihedral angle MNPQ are equal.

(2.) Let the dihedral angles MNPQ, M′N′P′Q′ be equal to one another; and let BAC, B′A′C′ be their profile angles: these angles BAC, B′A′C′ will be equal.

For, conceive the plane M′N′ to be placed upon MN, so that P′N′ shall coincide with PN and the point A′ with A.

Then since A′ coincides with A, and P′N′ with PN and the planes M′N′, MN which contain the perpendiculars AB, A′B′ also coincide, the line A′B′ must coincide with AB.



Again; since the dihedral angles are equal, and M'N' coincides with MN and the line P'N' in the one plane coincides with PN in the other, the planes P'Q', PQ also coincide.

Finally: since P'N' in the plane P'Q' coincides with PN in the plane PQ, and the point A' in P'N' with the point A in PN, the perpendiculars A'C', AC in the coinciding planes must also coincide.

Wherefore the two sides B'A', A'C' coinciding with the two BA, AC, each with each, the angles B'A'C', BAC are equal.

(3.) Let (*preceding figure*) the two profile angles BAC, B'A'C' of the dihedral angles MNPQ, M'N'P'Q' be equal: the dihedral angles themselves will be equal.

For let, as before, the plane M'N' be placed upon MN, so that P'N' shall coincide with PN, and the point A' with the point A.

Then, as already shown, A'B' will coincide with AB. Also since A'C', AC will then be perpendicular PN, they will be in the same plane with the coinciding lines AB, A'B' (*prop.* 25), they being all perpendicular to the coinciding lines PN, P'N' at the coinciding points A, A'.

Wherefore, the angles BAC, B'A'C' being equal and in the same plane, and A'B' coinciding with AB, the line B'C' will coincide with the line BC. Consequently the planes PQ, P'Q' coinciding in the lines PN, P'N' and AC, A'C' they must wholly coincide (*ax.* 5); and hence the faces of the dihedral angles MNPQ, M'N'P'Q' coinciding, each with each, the dihedral angles formed by them will be equal.

(*To be continued.*)

MR. ADCOCK'S SPRAY AND WHEEL PUMPS AND THE "MECHANICS' MAGAZINE."

Sir,—Your correspondents, Mr. Brough and Mr. Clive, ask Mr. Adcock for information respecting his spray pump, which, for several reasons, I think they will not obtain.

In the first place, Mr. Adcock is a sworn enemy of your excellent miscellany. His early aversion to it arose from your presuming, in a criticism on his "Engineer's Pocket-Book," to point out too clearly its many inaccuracies, which led Mr. Adcock thus to express himself in an *Advertisement Raisonné* appended to his "Syllabus of a Course of Eight Lectures on Mechanical Philosophy:"*

"As Mr. Adcock *never reads the Mechanics' Magazine*, containing, as it does, so much trash, and disappointing so much the hopes of many of its earliest and best supporters, it was only through the intervention of a friend that he became aware of the present attack; he shall, therefore, not consider it worth his while to notice any subsequent one, even should he be apprised of it. On the contrary, he will treat it with the same silent contempt that he did the first, knowing that an attack *from such a quarter* cannot possibly injure him in the opinions of the respectable and thinking portion of the community."

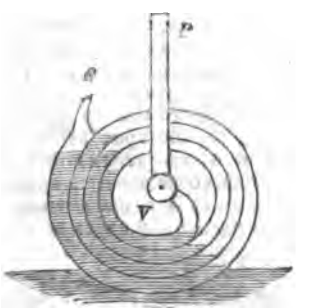
Never, I suppose, did flakes of snow falling on a rapid stream, tend less to stay its course, than this tirade to injure the journal against which it was fulminated..

* Leeds, Baines: London, Weale. 12mo., price 2s. 6d.

Secondly, Although Mr. Adcock "never reads the *Mechanics' Magazine*," and stood pledged, as we have seen, never to notice anything that appeared in it, "even though he should be apprised of it" by others, yet, not long ago, Mr. Adcock did reply at length to sundry attacks made in the *Mechanics' Magazine* on his spray pump, and through the medium of the Magazine itself! Admirable consistency this! To have been inconsistent once, however, is no reason for anticipating that a man may not be equally so again. No! my reason here for expecting no answer from Mr. Adcock to the questions of Mr. Brough and Mr. Clive is simply this—that he got so mauled on the last occasion of his figuring in your Journal, that we may be quite sure he will never risk a repetition of the process.

It appears from some recent correspondence in the *Mining Journal*, that the spray pump has been removed from Llanhiddel, where the powerful machinery required to work it is represented to have caused quite a tremor of the ground for some distance, and to have so shattered the foundations of the blast cylinder, boilers, &c., that great repairs have been required in consequence. These statements—the latest made on the subject—have not been contradicted by Mr. Adcock, and this I can only attribute to their truthfulness.

Mr. Adcock exhibits, at premises in the Strand, a patent wheel pump, which, to my great surprise, I found to be no other than a new edition, without improvements, of the *Zurich machine;* of which a description may be found in Dr. Gregory's "*Mathematics* for *Practical* Men," 8vo., 1833. Referring to the annexed diagram, he says, "the curved



pipe is connected at its inner end by a central water-tight joint to an ascending pipe, *v*P, while the other end, S, receives during each revolution nearly equal quantities of air and water," (p. 344.) This pump, invented by Andrew Wirtz, of Zurich, in 1746, has been successfully used in Florence, Russia, and other countries; and Dr. Young states that it had raised water 40 feet. That a person of no pretensions to knowledge should patent an old or useless invention, is nothing strange; but that a gentleman who sets himself up for a teacher of "mechanical philosophy," and a writer of hand-books for civil engineers, should attempt to appropriate to himself an invention above a century old, and made popular by the publications of so celebrated a writer as Dr. Gregory, is as monstrous as it is inexcusable.—I am, Sir, yours, &c.,

A PRACTICAL ENGINEER.

Piccadilly, London, Jan. 14th, 1848.

[We were not before aware that Mr. Adcock had expressed himself in such civil terms of the *Mechanics' Magazine*, and might now, perhaps, leave his remarks to speak for themselves, without much fear of suffering aught by our silence. Whatever may have become of "the flake," certain it is that the river still flows on, and as copiously as ever. It may not, however, be altogether out of place to mention that the review of the Engineers' Pocket Book, which appears to have given such mortal offence to Mr. Adcock, and against which he affects to appeal with so much confidence to the "respectable and thinking portion of the community," was written by a gentleman (now no more) who was not only one of the first mathematicians and most popular scientific writers of his times, but equally distinguished for the rectitude and honesty of his opinions. Mr. Adcock may add this, if he pleases, to the next edition of his *Advertisement Raisonne*. ED. M. M.]

Greek Fire.—Mr. Brown, of Ohio, the inventor of a Greek fire, obtained from the American Government an appropriation of 10,000 dollars, for the purpose of putting the efficacy of his fire to a decisive test, and accordingly a grand public experiment was made in full view of the President's house. The *Washington Union* describes it thus:—"A boat with the engine in it, for throwing off the fire, was towed near a tall mast, with barrels of combustible materials fastened upon it from top to bottom. When within 15 or 20 yards of the mast, a stream of fire was thrown upon it, and set fire to the barrels and the combustibles in them, and which were entirely consumed."—(Oct. 30, 1847.)

BALLS' PORTABLE SUSPENDING AND REVOLVING OVEN.

[Registered under the Act for the Protection of Articles of Utility. Mr. Thomas Balls, of Enfield, Inventor and Proprietor.]

Fig. 1.

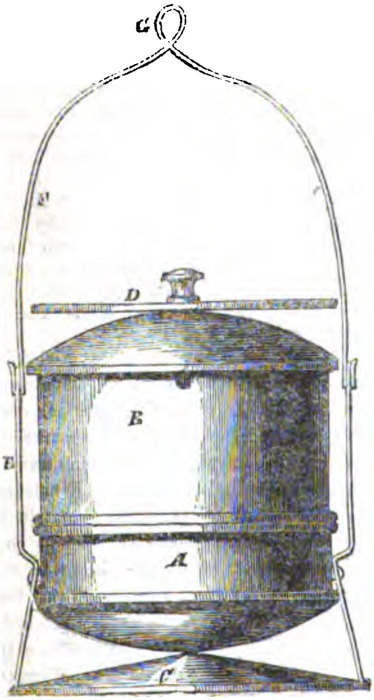


Fig. 2.

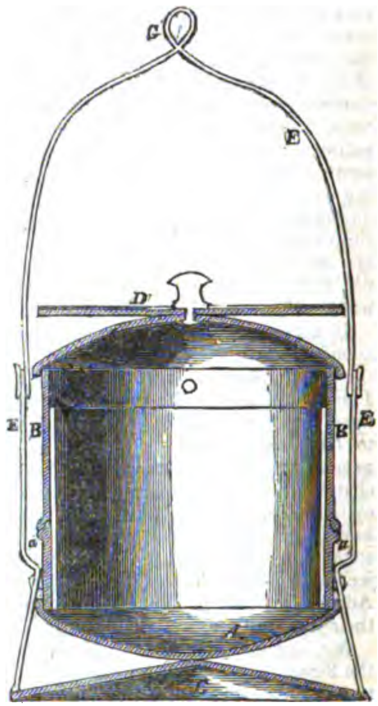
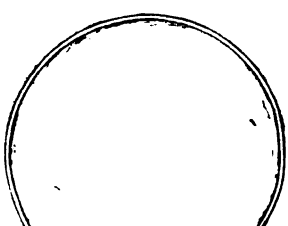


Fig. 3.



This is a valuable addition to kitchen and cottage furniture; quicker in operation, more convenient, and much cheaper than any other portable oven with which we are acquainted. We speak thus favorably of it, from personal experience of its advantages.

Figure 1 is an external elevation, and fig. 2 a vertical section of the oven. A is the body of the oven; and B a cover made to fit it exactly, abutting at bottom against a ring, *a*, formed on the outside of A.—The bottom of A and top of B are both made of a convex form, as shown.—C is a plate, of a conical form, which is so placed that its apex touches, or nearly so, the apex of the convex bottom of A, and reflects the rays of heat which strike upon it upwards towards A. D is a flat circular plate, which is riveted to the apex of the cover B, and reflects down upon it all the rays of heat which it intercepts. EE are two lugs by which the parts A and C are connected. F is a bail or handle, which is attached by hooks to the ends of the lugs, EE, and has a ring, G, at top, by

which the cover may be suspended from the roasting-jack commonly used in kitchens, and thereby made to revolve in front of the fire.

When bread or any other like article is baked in this oven, it is advisable to place it within a tin envelope (such as represented in plan, in fig. 3,) in order that it may not adhere to the sides of the oven, and that it may be readily removed. The envelope is cut through, so that it may fit articles of different sizes, and be itself easily taken away.

BAKER'S "RAILWAY ENGINEERING,"*

Mr. Baker gives a history of the authorship of this work, which is of such a nature as to challenge no ordinary degree of scrutiny. He says (Preface vii., viii.) that the matter contained in his pages was, "with the exception of a few additions and improvements, drawn up *about twenty-five years ago for private use;*" that, so far as the laying out of railway curves is concerned, he "*anticipated above twenty years ago* all that has been since done by other authors (Law, Castle, Rankin, Brodie, &c.) *at least as far as real practical utility is concerned*" —that his method of "finding the contents of cuttings from sectional areas is, as *far as I know*, the *only one mathematically correct yet published, having been prepared for private use many years ago*,"—that neither M'Neil, nor Bidder, nor Bashforth, nor Sibley, nor Rutherford, nor Huntingdon, nor Law, give "directions for finding the contents (of cuttings) from sectional areas, *except Mr. Bashforth, whose method of applying them is erroneous:*" and finally, that he "can truly say, that the whole of the matter contained in this small volume, *with some few trifling exceptions*, was originally drawn up by me;" and that "the *most essential parts* have either been published or communicated to my friends for periods *varying from ten to twenty-five years.*"

Such pretensions as these are easily set up, especially when couched in such vague terms as "*about* twenty-five years," "*above* twenty," "*many* years ago," &c.; and when loopholed with such convenient qualifications as "*at least*" "*as far as I know*," &c. and not to be tolerated except upon the most clear and irrefragible evidence. If a man's own bare word were to be taken in such a case, there would be no safety whatever for literary property or character. Not a single author could be sure of not seeing his place usurped, some day or other, by some chattering jackdaw or self-inflated frog.

We need not go farther than Mr. Baker's own statement of his case to be satisfied that it is one entitled to but small regard. In the first instance, he alleges that the matter, "with the exception of a few additions and improvements, was drawn up about *twenty-five years ago* for private use." "*Drawn up*, for private use" only, be it observed, not *published*; yet, at the conclusion, he ventures on the bolder assertion, that "the most essential parts have *either been published or communicated* to my friends for periods varying *from ten to twenty-five years.*" Here we have two statements, which, if not wholly inconsistent with one another, display a want of conformity which bespeaks a most suspicious degree of confusion in the author's own impressions as to the real state of the case. Again; what were the "most essential parts" that were "published or communicated?" And at what precise date did the publication or communication of each take place; and *where*, or to *whom?* It is certain that, in a court of justice, pleas worded in so loose and indefinite a style as these, would not be admitted to proof at all; and we see no reason why, in a court of criticism, they should be treated with any greater consideration.

We shall pass over unexamined the first two sections of the work in which Mr. Baker gives various methods of "laying out curves on the ground," and of "setting out the widths of ground for railway," as well as some supplementary "Remarks" in which he endeavours to support, so far, his claims to being the grand precursor of everybody else, in order to come to his "Section Third" which treats of "Railway Cuttings in general," and of Mr. Bashforth's errors

* Railway Engineering, or Field Work, Preparatory to the Construction of Railways. Containing a General Table for the Calculation of Earthworks. By T. Baker, C.E. pp. 64, 8vo. Longman and Co.

on this head in particular. We do so, because having not long ago had occasion to review Mr. Bashforth's Table we have a lively recollection of its merits, and can tell better (perhaps) from the way in which Mr. Baker disputes the palm of originality with Mr. Bashforth, what value to set on his pretensions in general, than from any other portion of his work.

The way in which Mr. Baker supplants Mr. Bashforth is in brief and simply this:—He quietly appropriates to himself all that is in Mr. Bashforth's book, with scarce a single exception, and without the slightest acknowledgment—making no material change in the substance of the matters thus unscrupulously appropriated (which was beyond his power), but varying somewhat the form in which they are presented, so as to produce a seeming difference where real difference there is none (which it is in the power of any clever trickster in any case to do); never attempting to show that he had ever before published or thought of any of the methods which he here falsely gives as his own; but leaving it—designedly and purposely leaving it—to be inferred, that they fall under the general category of having been either published or "communicated" by him "to his friends for periods varying from ten to twenty-five years." "Yet how," some simple reader may ask, "can this be? Has not Mr. Baker taken pains to show that Mr. Bashforth is erroneous, and would he have done so if his methods were substantially the same as Mr. Bashforth's?" Listen, oh! simple reader, while we explain how this is. The pains taken to show Mr. Bashforth to be erroneous, have been taken precisely because the methods are substantially the same, (as we engage immediately to show,) and for the express purpose of thereby producing on the minds of such "simple" readers the false impression that there must needs be some real difference between them. It is an old and familiar trick this, of the piratical craft. Of real difference—of material error—there is none in the case; it is all made up of distortion and exaggeration. Mr. Baker himself may tell us, however, (now that he is taken to task for his statements,) that he meant only to impute error, not piracy to Mr. Bashforth.—Let us see then how this pretence would hold good. Mr. Baker claims the whole of the "essential parts" of the work as his own, and as having been "either published or communicated" by him "from ten to twenty-five years ago;" and doubtless he includes in the number his "Third Section," which is as essential and important a portion of the work as any. He must, therefore, mean to impute piracy to any and everyone who may have subsequently published as his own any of these "essential parts," and he cannot be supposed to have excepted Mr. Bashforth, the contents of whose book are identical (as no one knows better than Mr. Baker,) with the contents of his "Third Section." Again: however the question of identity between Mr. Bashforth's book and Mr. Baker's "Third Section" may be determined, Mr. Baker must be held bound to make this good at all events; namely, that the matter of his "Third Section" was "either published or communicated" some ten, fifteen, or twenty-five years ago, and long, of course, before the appearance of Mr. Bashforth's book. Has he adduced any evidence of this?—Not a tittle. Is it in his power to adduce any such evidence? We believe not. We think we may safely challenge him to show that the matter of a single page or passage of his "Third Section" was ever published anywhere, in any shape, or communicated to any one in any part of the world, before it appeared in Mr. Bashforth's book. And if he cannot meet this challenge—if he cannot show that any prior publication existed from which Mr. Bashforth could have borrowed, or that any of "my friends" communicated to Mr. Bashforth what Mr. Bashforth has published, it follows that it is Mr. Baker, and not Mr. Bashforth, who must be looked on as the pirate.

Our engineering readers may perhaps remember, that the peculiar and distinguishing feature of Mr. Bashforth's method of calculating the contents of railway cuttings, consisted in subtracting what is called "the *top* prism" in his calculations. He was the first,

to the best of our knowledge, who introduced this principle of calculation, and we shall continue to believe so, until Mr. Baker or some one else can show us a trace of it in some prior publication. Mr. Baker's method—the grand peculiarity on which all *his* claims to originality turn—consists in subtracting the *bottom* prism! It is the old case over again—only in another shape—of Watt's steam-engine turned upside down;—a distinction without a difference, and involving no result of the smallest practical consequence, one way or other.

Of this there can be no better proof than the fact, that Mr. Baker adopts precisely the same system of calculation on the bottom prism principle, as Mr. Bashforth does on that of the top prism. He follows implicitly Mr. Bashforth's plan of measuring heights from the intersection of the slopes, and copies also his method of extending them to fractional parts of a foot by reference to a separate table—which table, by the way, he has sadly mangled. He gives, too, Mr. Bashforth's methods of extending the general table to heights beyond those in the table, and of ascertaining the contents of cuttings by collating the square roots of the sectional areas with the general table. All this, of course, without the slightest acknowledgments; as if they were things of his own imagining and elaboration, instead of being—as they were—prepared to his hand by Mr. Bashforth. Indeed, the only part of Mr. Bashforth's system which he does not adopt, is his interpolation of heights—a part which was not Mr. Bashforth's own, and admitted to be so.

In Art. 4 of his work, Mr. Bashforth gives a rule for finding the contents of cuttings where the surface of the ground is *level*, and he states that it applies "to all other *similar* and *similarly* situated figures of the ends of the prismoids," and those only. But where the ground is uneven, he gives another rule (Art. 15,) which is, of necessity, somewhat different. Mr. Baker admits the former rule to be "mathematically accurate," but denies the like credit to the latter; and makes it a matter of serious charge against Mr. Bashforth that the two rules are not equally exact. In a quantity of some 28,058 yards (Art. 20,) there might, by strictly following out the second rule, be an error of some SIX cubic yards or so!—A mighty matter this, on which to found a scientific impeachment! No doubt the rule called in question is "*mathematically* inaccurate;" but it is manifest, from the manner in which Mr. Bashforth enunciates it, that it was a rule intended only for approximative accuracy,—one which could produce no error of moment in actual practice, while it possessed all the advantages of simplicity, brevity, and convenience. To "show the magnitude" of the error which may result from adherence to this rule, Mr. Baker gives us a case (p. 48,) where, according to his calculations, the error may amount to 7½ per cent.; but it is a case of so extreme a character, that it may be safely pronounced as one of impossible occurrence. The cutting is assumed to increase from 2 feet to 79.6 feet within the distance of 4 chains, *without any intermediate cross section!* Who ever before heard of an engineer's calculating the contents of a cutting of so uneven a piece of ground with such a distance between his cross sections as this? Accuracy in such cases is only to be approached by very frequent sections—one at every chain, at least. And supposing such sections to be taken, Mr. Bashforth's rule would not give a hundredth part of the amount of error ascribed to it on Mr. Baker's absurd premises.

Mr. Baker, to be sure, sneers at "numerous cross sections." They are expensive—they are troublesome (p. 56.) Perhaps so; yet, nevertheless, they are absolutely necessary to proper calculation. The irregularities of the surface of the ground is such, in nearly every case, that it is only by very frequent measurements, that anything like an approximation to the truth can be arrived at.

Mr. Baker refers in the following terms to a letter from Mr. Bashforth, which appeared some time ago in our Journal:

"Mr. Bashforth says, *in defence of his method of finding the contents* from sectional areas, in the *Mechanics' Magazine* for Sept. 11, 1847, p. 249—'In the case of contract

estimates, numerous cross sections ought to be taken; and it matters little whether we start from the intersection of the slopes or the formation level.'"

This is a wilful perversion of the intent and meaning of the letter referred to. It was not a letter "in defence of his method of finding the contents from sectional areas," which is not once mentioned in it, either directly or indirectly, but a letter relating to an entirely different matter. We had—somewhat inadvertently, we confess—made a comparison between Mr. Bashforth's Table and those of some other authors in point of *extent:* and the purpose of Mr. Bashforth in writing to us, was to point out that, since he measured from the intersection of the slopes, while the other writers alluded to (Macneill, Bidder, &c.) measured from the formation level, no such comparison could fairly be instituted between them, since it was just as easy to apply the zero of the scale to the one part as to the other. He was not called upon to make any "defence" of his method of finding the contents of sectional areas; neither did he make any.

From the manner in which Mr. Baker has treated Mr. Bashforth, we may see clearly, that when his own glorification is to be promoted, he is not a person to stick at trifles. To an inordinate love of appropriation he adds what is in most convenient harmony with it—a perfect freedom from scruples of every sort. (We mean this, of course, in a literary sense only.) He is just the kind of individual, whose assertion that he had done this or that years ago, would induce one to believe that there is nothing in it. He is one who has fallen into a habit of boasting, and is by mere persistance in it as likely to end in deceiving himself as others. It is a habit the more vicious and reprehensible that Mr. Baker is a man of talents withal, and brags with a degree of plausibility, exceedingly apt to impose on people who may not be aware of his peculiar idiosyncrasy. We could quote some very fair specimens of ability from the work before us; and should do so with pleasure were we not withheld by a discreet apprehension of being betrayed into commendation of Mr. Baker for things which Mr. Baker may have but borrowed at second-hand from others. We know not how far we can trust him: and therefore do not trust him at all. He may thus miss obtaining the credit which is really his due; but if he does so, the fault is his own.

DEFECTIVE GAS-FITTINGS — RUTTER'S UNION SYPHON — JENNINGS' PATENT HERMETIC COCKS.

Sir,—I read with much pleasure the communication of Mr. Rutter in your last Number, on the evils arising from want of care and want of skill in the arrangement and execution of *gas-fittings.* What with ignorance on the one hand, and the injurious effects of excessive competition on the other, gas-fitting, as an art, is at the lowest ebb, and the disastrous accidents arising from defective fittings, which are of almost daily occurrence, call loudly for a radical reform. Mr. Rutter particularly alludes to, and proposes a remedy for, a very frequent annoyance to which gas-consumers are subjected—the obstructed passage of the gas-way by water collected in the bends of the pipe.

In the majority of cases, by the exercise of a little skill the pipes may be so arranged that any condensed vapour will run back into the meter—the source from which by far the largest quantity is derived—and preserve the proper water-level therein, obviating the loss and inconvenience which result from deficiency of water. It does sometimes happen that this arrangement is not feasible, and the next best thing is then to fix upon a joint to which the condensed vapour will be determined, and thence removed when its presence becomes inconveniently evident.

Mr. Rutter proposes a *union syphon,* for the purpose of collecting and removing the condensed vapour; but I think a little reflection will suffice to show that this contrivance is by no means well adapted for the proposed object.

A very good plan is to give the pipe a decided bend at the lowest and most convenient part, and insert a stop-cock or screw-plug; but the last is objectionable on account of its liability to be dropped and lost. As soon as the flickering of the lights shows the accumulation of water, it is only to open the stop-cock and per-

mit the water to escape into a convenient vessel; when, without disturbing the lights, or causing any unpleasant smell, the evil is remedied. It almost invariably happens that the evil is unknown till the lights are burning; and if Mr. Rutter's *union syphon* is used, it would then be necessary to turn off the gas at the main-cock, and extinguish every light; proper wrenches are then requisite for disconnecting union-joints, and the gas remaining in the pipes escapes into the premises. The *syphon* being emptied, is replaced, and the joints remade, with the risk of being imperfectly done: the gas has then to be turned on, and the burners lit. All this trouble, delay, and inconvenience, is avoided by the use of a simple stop-cock: and the only objection raised to it by Mr Rutter, is the liability of the *plug* of the cock to set fast when not frequently turned. This objection cannot possibly apply to stop-cocks having no *plug*—Carter's for instance. This ingenious contrivance has been pretty extensively used in the best gas-fittings, but it is now likely to give way under the influences of a still more ingenious rival!

Mr. Josiah Jennings has recently patented an india-rubber stop-cock for gas and water, which promises to supersede all other forms, being free from every one of the defects to which all previous cocks were more or less liable. I hope very shortly to be enabled to make your readers acquainted with the peculiarities of this beautiful invention.

The sum of this matter appears to be, that a (perfect) stop-cock is greatly preferable to Mr. Rutter's *union syphon*, connected as it may be with a vessel of any capacity for collecting the condensed vapour for, if required, a whole season. The stop-cock is the simplest, the safest, and by far the most convenient of the two. I remain, Sir, Yours, &c.,

WILLIAM BADDELEY.

29, Alfred-street, Islington,
January 27, 1848.

A HINDOO GENIUS.

A native of Calcutta, by hereditary profession a blacksmith, who was employed for many years in cutting punches for the press, having now little occupation, has adopted the following ingenious mode of obtaining a livelihood:—He has manufactured an iron press upon the model of one of those in use here, and set up a printing-office, at which he has commenced printing for the country at large. Last year he produced a native almanack, of a superior character, which had a remarkable run. Soon after this he began to engrave on lead pictures of the gods and goddesses of the Hindoo Pantheon, of which hundreds of thousands were struck off on inferior paper, and obtained a ready sale. Some of them were afterwards adorned by the art of the limner, and, being set in frames, sold of course for a higher price. Hawkers were employed in traversing the country with packs of these mythological prints, both on account of our Serampore printer and others who found it advantageous to imitate his example at Calcutta. Hence there are few villages to be found in a circle of many miles round the country in which the cottage of perhaps the poorest individual is not supplied with the veritable effigy of some one of the popular gods. The supply, however, soon became too great for the demand, and his competitors relinquished the trade, which has since languished, and is now confined to a very limited extent. But his ingenuity was not exhausted. He determined to print English books for the numerous youths of the poorer classes, who are now endeavouring to obtain a smattering of our tongue, and for whom even the low-priced elementary works of the Calcutta School Book Society are too high. Of these works thousands of pirated copies have been printed in Calcutta and disseminated through the country. But the individual we allude to, finding English type at second-hand too dear for his purpose, has cut a set of punches for himself, and cast the types which he employs for this work. They are entirely wanting in that beauty and exquisite accuracy which characterise English types, but to an inexperienced eye the difference between them from letters cast in Europe or America would scarcely be apparent; and to a native, the inferiority would be altogether imperceptible. Thus furnished with his own apparatus of a typographical establishment, he is enabled to produce works at so cheap a rate as completely to undersell the presses in Calcutta. The native booksellers in that city—a rising race, though at present of little note—are happy to avail themselves of his labours, and purchase edition after edition of his cheap books. As soon as education in the vernacular language becomes the order of the day, it is by such men and such means that books will be multiplied. Capital will be poured in upon the enterprise; the natives who are acquainted both with English and Bengalee will find it to their advantage to cater for the press, and the means of improvement will be placed within the reach of the middling and lower classes of society.—*Calcutta Gazette.*

NEW SPIRAL BOLT.

Mr. W. T. Steiger, of the General Land-office at Washington city, has invented a spiral bolt, for which he has obtained a patent, which is likely to become very useful. It consists of a spiral spike to be used in every description of frame work, but more particularly in building ships and other marine structures. The invention is remarkable for simplicity, and, in the opinion of competent judges highly important in imparting strength and, durability to such objects as require the use of bolts or spikes in their construction. These bolts are made by simply reducing bars of copper or iron of a square, triangular, or any other polygonal section, to a regular spiral form, by twisting them, or by any other convenient means, by which the angles become the thread of a screw; afterwards, they are cut into lengths and formed into bolts of various sizes, either with or without necks and heads. Where the timbers to be secured lie in contact, they require no head at all, the upper timber being held down by the spiral threads.

The points are made by setting down the spiral with half-round swages to a cylinder, or cone; and the front edges of the threads being sharpened by filing or any other means, become a regular tool for making the incision in the wood. They are driven, like other bolts, with a hammer or maul, after boring a hole, and cut their thread in the hardest seasoned live-oak in the most perfect manner, entering it with a rotary motion; and have, when in place, all the grip or tenacity of screws. The expense of making them, it is estimated, will be no more than the common round bolts, for the reason that all the fibres within the diameter of the bolt are cut transversely, by which the lateral pressure is avoided, and, by the operation of making them, a spiral arrangement is given to the fibres, imparting toughness to the iron, and every inch of the bar is tested, so that the hidden flaws, if any exist, are detected and exposed. They are easily backed out by punching against their points, and admit of being protected from corrosion by the application of resinous substances in a fluid state, injected laterally into the capillary tubes or grain of the wood.

These bolts have lately been subjected to some experiments at the Washington Navy Yard, and the results were satisfactory. It is said that they are adapted to the construction of gun-carriages, cars, and other wooden structures. Arrangements have recently been made for giving them a trial on a large steamboat of 1,100 tons burthen, now being built by Messrs. Simpson & Co. of this city. The invention has been approved of by a number of experienced and scientific men, among them Col. J. J. Abert, of the corps of Topographical Engineers.—*Scientific American.*

[From the account which we gave in our last No. of Mr. Melling's Iron Twisting Machine—more than a year old—it is evident that our American friends have been completely anticipated in respect of this very useful invention.]—Ed. M. M.

JACQUARD IRON PLATE PERFORATING MACHINE.

[The machine described in the following article, was made for Mr. Evans, the contractor for the iron bridge which is to carry the Chester and Holyhead Railway over the river Conway. The present description of it is extracted from a paper read by Mr. Fothergill to the Institution of Mechanical Engineers at their last meeting, and reported in the *Railway Chronicle.*]

The machine employed to perforate the plates for the iron tubular bridge, which is to carry the Chester and Holyhead Railway over the river Conway, is at present adapted ot punch such pitches only as that work requires, viz. 3 inches and 4 inches from centre to centre of rivet-holes, with latitude for departing considerably from those general pitches in the lateral rows of the holes. This machine is constructed to perforate, at each stroke, a row of holes across a plate 3 ft. 5 in. broad; but, by employing a series of card plates, (similar to the cards used in the Jacquard loom,) any number of punches may be put out of action at pleasure; and by means of a blank card at the end of the series, the machine is put out of action at a point where no obstacle is presented to the taking out of the perforated plate and putting a blank plate in its stead. The operation of changing plates weighing six or seven hundred weight each, is performed by half-a-dozen men in less than one minute; and whilst one plate is being punched, these men get another ready to put into the machine. As these machines take eleven to twelve strokes per minute, it follows that (with a 4-inch pitch) a 12 ft. plate may be punched in less than four minutes; and consequently that, allowing one minute for changing, it may perforate twelve such plates per hour. Many of the plates in the bridge are 12 ft. long, 2 ft. 8 in. broad, and ¾ in. thick, and are punched for rivets 1 in. in diameter. As there are but few engineering concerns where such a perforating machine as that at Conway could be employed more than an hour or two per day, it appears to me to be very desirable that ironmasters should have them,

and that they should also have machines for straightening and bending plates; by these means the ironmasters would be enabled to supply their customers with plates in a fit state for being riveted together. Were this system brought into practice, engineers would turn their attention to adapt their work to the capabilities of the perforating machine, and thus great perfection, despatch, and economy of construction would be the result. A drawing represented a machine, (similar in principle to that already described,) adapted to perforating paper and thin sheet metal, such as sieves and window-blinds are made of, in which plain perforations, arranged in squares, may be made by a single row of punches; and perforations, arranged quincuncially, may also be made by a single row of punches, by giving to the plate a lateral alternating motion; but a double row of punches, arranged intermediately to each other, is preferable. Each of these arrangements admits of a great variety of fancy patterns by the application of the Jacquard principle. A large class of patterns may be produced by punches of various forms and sizes, which shall be so grouped together as to give to the work a columnar effect; and the range of this class may be extended by giving the plate a zig-zag or waved motion, and still further extended by combining it with the Jacquard. Another class of patterns may be produced by employing two distinct sets of punches, of different size or form, and with each set a Jacquard, to bring punches of the one or other set into action as required, and thus be made to produce representations of figures, landscapes, &c., at pleasure. A further variety of patterns might be produced by the introduction at intervals of punches containing set patterns, such as sprigs, flowers, &c., and perforating the ground with small punches. The foregoing is but a brief description of the capabilities of the Jacquard perforating machine, which in good hands would be found to be nearly co-extensive with those of the Jacquard loom. Another drawing represented a double-acting machine for shearing (at one side,) and punching (on the other,) at the same time, plates of iron $\frac{3}{4}$ in. in thickness with holes $1\frac{1}{2}$ in. in diameter, and to perform both processes to the extent of 18 in. from the edge of the plate.—The Chairman said it was a machine represented as peculiarly adapted for perforating plates used in ship steam-boilers, girders, &c. But, from the description, it appeared to him to be a very useful machine for steam-boilers generally. Seeing the great accuracy with which the punch is made, it would be rather interesting to follow out the applicability of the machine.—Mr. Ald. Thornton asked if the machine punched in any other than a straight direction?—Mr. Fothergill said it did, and it would punch twelve holes at once.—Mr. Beyer thought it was a very excellent punching-machine, and it might be applied, to a great extent, and to all ordinary-sized boilers.—In answer to questions by various members, Mr. Fothergill said, all the punches acted upon the plate at the same time.

EXTINCTION OF FIRES.

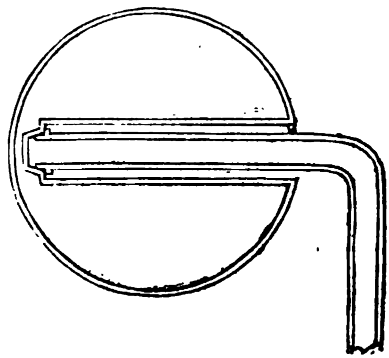
An admirable contrivance for speedily extinguishing fires has been adopted by Mr. Alex. Annandale, at his large paper-mill at Polton, near Edinburgh. The following is an account of this ingenious apparatus:—The apparatus may be said to combine, in itself, a complete fire-brigade, and an engine for the elevation of water. It consists simply of two pumps, with capacious air-vessels, one of these pumps being worked by a steam-engine, the other by a water-wheel. These being the movers of the machinery of the mill, are consequently kept in constant action, and therefore always ready for the accident of fire. The original object of these pumps was to raise water from the river into a reservoir for the supply of the mill; but, by the addition of a common valve, the desired results are effected. On the orifice of the pipe from the pumps, where it delivers its water into the reservoir, is placed the valve, which is equal in area to the pipe. It has the ordinary lever which is generally attached to the safety-valve of steam-boilers. This valve can be loaded to any extent, by moving the weight along the lever, and consequently preventing the delivery of water into the reservoir, but under a pressure capable of raising the valve, which is regulated so that it will open before the pipes or pumps are subjected to such a strain as may endanger their bursting; as a natural result, therefore, this pressure is transmitted to the water in every part of the pipe. Attached to the pipes from the pumps (and in such situations as may command with ease every portion of the works,) are the means of fixing a number of leather hose-pipes, with their conductors. In one situation in front of the building, six of these hose-pipes can be attached. By merely lifting a wooden cover, which is level with the ground, we find six nozzles, with water-tight caps screwed upon them, which are removed to give place to one or more of the hose-pipes, when wanted. A slide-cock admits the water at once to all those nozzles from the main-pump pipe. On two of these leather hose being brought out and fixed upon this pipe,

and the weight drawn along the lever of the valve and the slide-cock opened, an unbroken jet of water from each of the nozzles is projected over the highest part of the building, equal in intensity, and superior in steadiness, to that of any two of the best fire-engines. But this is not all; at the same time the other four hose-pipes can be attached and brought to act in the same manner, and with the like efficiency, and the mill may be thus speedily deluged. The whole operation does not occupy two men five minutes. Had such an apparatus been in existence two years ago, the whole of this valuable property, which was then burnt to the ground, might have been saved. In many places, advantage has been taken of the simple gravitation of water, as a means of extinguishing fires; and where a competent head of water can be obtained, and the pipes are of sufficient capacity, and laid for that purpose alone, nothing more need be desired; but this cannot always be obtained but at an immense expense, and in some situations not at all. The striking peculiarity of the Polton Mill apparatus is its applicability to towns as well as mills; for any desired pressure may be given to water without resorting to the expense of having elevated reservoirs. Take, for example, the city of Edinburgh, which has many sources of water in its neighbourhood which might be made available for the cleansing of sewers, streets, closes, and for other sanitary purposes, as well as for the extinction of fire. An engine placed at the Canal Basin, and a train of pipes laid through the principal streets, with the necessary means of attaching leather hose-pipes, might be used for these objects. The engine could be made to work a number of pumps, discharging water into one large air-vessel,—the safety-valve, as it may be termed, or a series of valves, to be placed, not at the extremity of the pipe, but at the pumps, under the control of the engineer. Supposing the whole train of pipes to be filled, and the pumps discharging a small portion of their water through the safety-valve, which may be loaded to such an extent as may be equivalent to a head of water, limited only by the power of the engine and strength of the material, it is evident that such pressure and such quantity of water as the pumps can deliver, will be transmitted through the whole train of pipe, subject only to the deduction arising from the friction along the pipe, and that the load on the engine will always be equal to the load on the valve and the quantity of water delivered; and this need never be more than what is necessary for the purpose in hand. To any one at all conversant with the principles of hydraulics, all this will be evident. To render the whole arrangement complete for a large city, might not the electric telegraph, or some concerted signal, be introduced to transmit intelligence from any distant locality to the engineer at the engine, when instantly the pumps could be set in motion? A somewhat similar system has already been adopted at the Liverpool Docks, where nine miles of pipe for fire-extinction alone have been laid. It is even projected to carry such pipes through the whole streets of Liverpool, with a hose-connection at every lamp-post.

W. K.

Edinburgh, Jan. 26, 1848.

IMPROVED BALL-COCK.



Sir,—The above is a section of an improved ball-cock, the construction of which will be understood without any letters of reference. A copper ball has a cylinder (stopped up at the inner end) soldered into it; the feed-pipe is bent, and inserted into the cylinder, so that the ball may move freely up or down: the lower end of the feed-pipe has a projecting edge and rim, which is ground so as to fit the bottom of the cylinder, like the safety-valve of a steam-engine; at the open mouth of the cylinder two small pins are fixed, so that these catch on the rim at the bottom of the feed-pipe, and prevent the ball from falling off. When the cistern is empty, the ball falls, and so the bottom of the cylinder is separated from the feed-pipe, and the water fills the said cylinder and runs over into the cistern. When the water rises, it presses up the ball, and allows no more water to enter.

I am, Sir, yours, &c.,
M. Tidd.

INQUIRIES AND ANSWERS TO INQUIRIES.

Accordions.—"How are the brass and steel employed for the tongue-notes of accordions hardened?"—*G. G.*

Tin.—"Experimentalist." There are three sorts of tin, 1, block tin, so called from its being cast in the form of blocks; 2, bar tin which is formed by running the tin into grooves in tables of granite; and 3, grain tin, which is formed by melting together in an iron vessel the better portions of the other two sorts. The third is by far the best, and is, from its superior purity, ordinarily used by dyers as a mordant.

Bar Iron.—"Is there any establishment in which bar iron is or can be manfactured tapering, say from 9 ins. to 3 ins. in width, and from 1 in. to one-eighth of an inch in thickness, and of any length, say from 30 to 50 feet, one edge being straight from end to end? If this cannot be done, can several bars be welded one on the end of the other, and hammered out to the length, width, and thickness abovenamed; and if so, will the iron be as strong at the welds as elsewhere, and at what price per ton can iron be so prepared?—*J. H.* Feb. 1."

The Jacquard Loom.—"B. K." Consult the volume of the "Cabinet Cyclopædia," on Silk Manufacture. It may be purchased separately for 6d.

The Engines of the Alice, &c.—"A Constant Subscriber," (Reading.) These engines are of the annular description, and were patented by Messrs. Maudslay and Co. Crickmer's oblique cylinder engine is also the subject of a patent.

Abandonment of Patents.—"If A. B. takes out a patent in 1837, and neither he nor his agents carry it into operation, is it considered abandoned? And may any one, or the public generally, use it? *Alfred Jones*, Jan. 31, 1848."—In this country no length of non-usage will nullify a patent: it continues in force for the whole term of fourteen years, whether carried into operation or not. Abroad, the case is otherwise: a patented invention, if not worked within certain given periods, is held to be abandoned.

Gutta Percha.—"Inventor." All the leading patents relating to the manufacture of this new substance have been published in this Journal. See Nos. 1180, 1181, 1182, 1183, 1185, 1200, 1232, 1235, 1253. It may be dissolved either in naphtha or bisulphuret of carbon. The latter is the better solvent, but objectionable on account of its exceedingly offensive smell.

NOTES AND NOTICES.

Monument to Newton.—An obelisk, 64 feet high, has been erected as a monument to Newton by the Rev. Charles Turnor, in the Park of Stoke Rochford, Lincolnshire,—the residence of his nephew, Christopher Turnor, Esq. Newton, when a child, went to a little day-school at Stoke,—which gives propriety to the site. The inscription is as follows: "In memory of Sir Isaac Newton, who was born at Woolsthorpe, an adjoining hamlet, and received the first rudiments of his education in the parish of Stoke. This obelisk was erected by Charles Turnor, M.A., F.R.S., Prebendary of Lincoln, A.D., MDCCCXLVII. May the inhabitants of the surrounding district recollect with pride that so great a philosopher drew his first breath in the immediate neighbourhood of this spot; and may such feelings long be perpetuated by this monument, which records the veneration of posterity for the memory of that illustrious man!"

Monument to Franklin.—A splendid block of granite has been erected on the spot where Benjamin Franklin was born, in Milk-street, Boston. On it, in enduring letters, is the following simple inscription: "The birth-place of Franklin."

Introduction of Steam into Austria.—Mr. G. Shepherd, C.E., informs us that a notice on this subject "from a correspondent," which we published in our last Number, appeared in the *Mining Journal* of October 30, 1847, p. 419, to which periodical it was furnished by him.

Dr. Ure and Joseph Lancaster.—I was exceedingly pleased with an anecdote related to me by a young friend, John Livingston, an engineer with whom I had formed an acquaintance. He said that Mr. Percival, brother of Robert, who was shot in the lobby of the House of Commons, and Joseph Lancaster, the founder of the Lancasterian system of teaching, came to Glasgow, to introduce the system there; they attended the Mechanics Institute, and heard Dr. Ure lecture on Chemistry to a well-filled house of working men in their working clothes. Ure it seems dealt somewhat in the abstract that evening, and after the lecture was over, Percival went up to him and said, "Dr. Ure, did these men understand the one half of what you said?" Ure was somewhat nettled for the honour of his country, and very pompously answered: "Why Mr. Percival, these men not only understand all that I said, but I can pick out two hundred of them that can lecture as ably upon the same subject as I can." "Oh, then," said Lancaster, "we are on a wildgoose chase, we are like coming to Glasgow from London with Glasgow coal."—*American Traveller—Scientific American.*

Railroad Sprinkler.—On the Stonington Railroad they carry a "Sprinkler," for the purpose of watering the track and road bed; thereby diminishing the friction of the cars upon the track, preventing the boxes and journals from being heated, by keeping away the dust, preserving the paint and varnish by not having to clean the cars so often, relieving the passengers from great annoyance, and taking from the brake-men a large share of their labour at the through stations. This improvement has been fully tested for the past two months upon the road, and found to be popular with travellers. It requires about two thousand gallons for the Stonington road, (forty-seven and a half miles). The machine is attached to the train behind the usual water-tank, and is under the control of the engine-man by a rope attached to a valve which he shuts and opens at pleasure. When it is in operation not a particle of dust appears inside or outside of the cars. In warm and dry weather the car windows can be left open without objection. This is a useful invention where there are tracks running through sandy districts.—*Providence Journal.*

Removal of a House.—A brick building at the corner of Tremont and Broomfield-streets, Boston, was moved lately 11 or 12 feet, including the cellar walls, upon a temporary railway, by means of jack screws. The building was estimated to be 500 tons in weight, but scarcely a jar was felt in the process of moving—not so much as the rolling of a barrel of flour upon the floor; and the contents of the grocery store, for which it was used, were not removed, but the ordinary business continued all the while without interruption. This is the first feat of the kind ever accomplished, and, as may readily be imagined, was a work of much difficulty. The process, as described in the *Whig*, was to first dig the new cellar, and lay a foundation wall to correspond with the old one. Upon this wall two iron bars were affixed, several inches apart, over which the building was to move on small iron rollers. Underneath the old wall a similar preparation was made. The difficulty of moving was made greater by the unevenness of the stones composing the wall, many of which were taken out, and their places substituted with others of a smooth surface. Six screws were used in the operation, which was done under the direction of James Brown, of Providence, Boston, R. I.—*Boston Journal.*

Tubular Railway.—A proposition has been started in Philadelphia, to have a large iron tube, three feet in diameter, to extend from Port Carbon to Philadelphia, a distance of 90 miles, to convey coal from the mines at Port Carbon to Philadelphia. The expense is estimated at about fourteen millions of dollars, and there is sufficient descent to make it practicable.

Preservation of Milk.—Mr. Yates, an extensive corn-factor, has presented to Mr. W. F. Wratislaw, of Rugby, a can of milk capable of being kept in a good and fresh state for an indefinite length of time, by means of a chemical process which it undergoes on being taken from the cow. It was manufactured at Foxall, near Stafford, on the estate of Earl Talbot; and it is said that the milk of seven hundred cows is daily acted upon by this novel invention, which must, in course of time, be a valuable acquisition in the victualling department of the navy, for which it is well adapted. The process has been patented, and not only may a rich sweet milk be constantly had, but also rich cream, convertible into butter in a very short time.—*Birmingham Gazette.*

Antiquity of the Arch.—Mr. Layard has discovered in the ruins of Nineveh positive proofs of the use of the arch. One small chamber is perfectly vaulted with unburnt bricks,—the diameter of the arch being 13 or 14 feet, and the form semicircular.

WEEKLY LIST OF NEW ENGLISH PATENTS.

John Collins, of Leominster, Hereford, architect, for certain improvements in furnaces, stoves, grates, and fireplaces, and in kilns and other apparatus for preparing vegetable and other substances, and the generation and application of heat. January 27; six months.

Thomas Robinson, of Coventry, ribbon manufacturer, for improvements in looms for weaving ribbons and other fabrics. January 27; six months.

William Watson Pattinson, of Felling, near Gateshead, Durham, chemical manufacturer, for improvements in the manufacture of Soda. January 27; six months.

William Henry Barlow, of Derby, civil engineer, for improvements in the manufacture of railway keys. January 27; six months.

William Russell, of Lydbrook, Gloucester, iron master, for an improvement in the preparation of such bar iron as is used in the manufacture of certain kinds of rod iron. January 29; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improved machinery for manufacturing shot and other solid balls. (Being a communication.) January 31; six months.

James Blackwell, of Winsford, Chester, salt proprietor, for certain improvements in evaporating furnaces. February 2; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Jan. 27	1331	William Groves, of the firm of Rich. Groves and Sons	Sheffield, tool-makers	Moveable double-handled file.
,,	1332	Thomas Edwards	Cambridge	Railway-signal.
28	1333	Richard Restell	35, High-street, Croydon, watch-maker	Fruit and seed protector.
,,	1334	Charles Bentley Bingley	Great Marlborough-street	A new design for the shape or configuration of an over-coat, called the Redingote.
,,	1335	Charles Thomas Green.	Woolwich	A new design for the shape or configuration of an instrument to be applied to the chimney or funnel of a steam-boat, in order to retain the upper part secure in the event of the ordinary hinges giving way.
29	1336	S. Mordan and Co.	City-road, London	Combined letter and stamping press.
,,	1337	S. Mordan and Co.	City-road, London	Label-damper.
31	1338	Chauncey Jerome, Jun.	Liverpool	Improved portable domestic cooking-stove.
Feb. 1	1339	John Mortimer	Aberdeen	Mortice and tenon-cutting machine.
2	1340	Andrew M'Laren	20, Steel-yard, Upper Thames-street, iron merchant and founder	Improved range-pinion and spindle.
,,	1341	Dent, Alcroft, and Co.	Wood-street, Cheapside	Elasticated tongue-piece for stocks, ties, and other articles for the neck.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

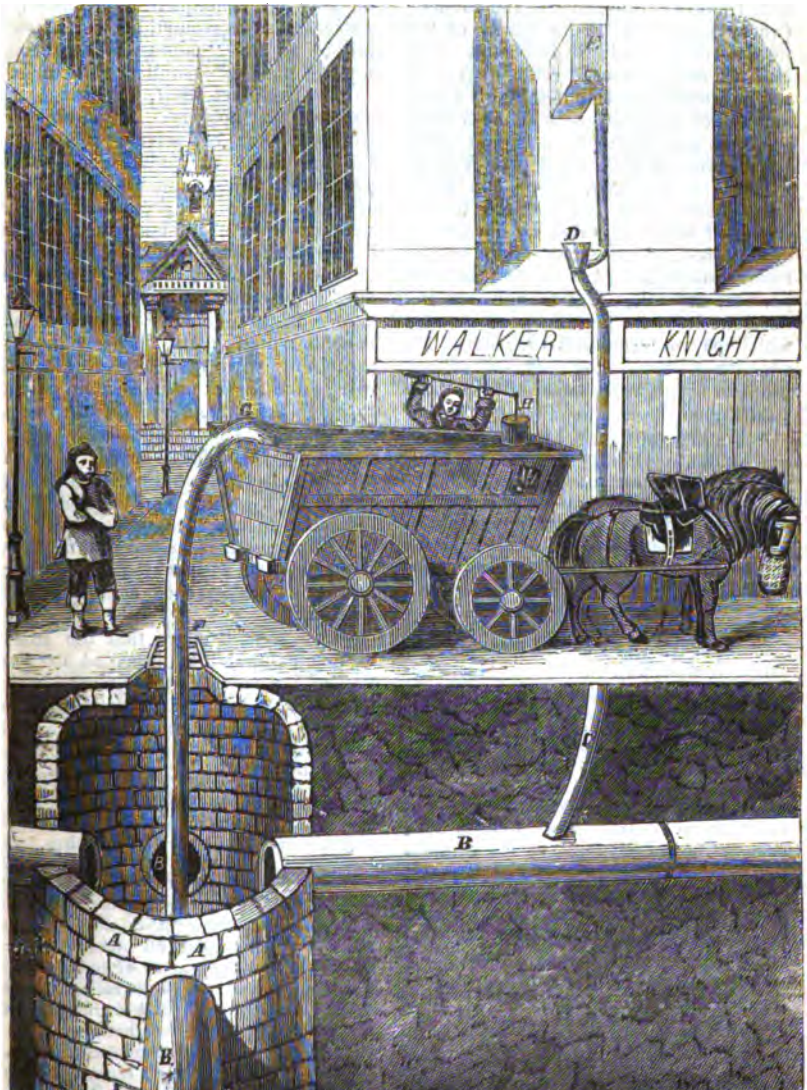
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1279.] SATURDAY, FEBRUARY 12, 1848. [Price 3*d*., Stamped, 4*d*.

Edited by J. C. Robertson, 166 Fleet-street.

SANITARY REFORM—ELLERMAN'S DEODORISING FLUID—DEAN, DRAY, AND DEAN'S AIR-TIGHT REMOVAL CART, ETC.

Fig. 1.



SANITARY REFORM—ELLERMAN'S DEODORISING FLUID—DEAN, DRAY, AND DEAN'S AIR-TIGHT NIGHTSOIL CART, ETC.

We have now before us the first of a promised series of Letters, addressed by Mr. Charles F. Ellerman to Lord Morpeth, the Chief Commissioner of the Woods and Forests, on the subject of "Sanitary Reform."* The author frankly admits, that as the patentee (query licensee or proprietor?) of "a newly-discovered disinfectant, that has attracted a considerable degree of public attention and elicited highly favorable notice in the columns of the leading scientific and other journals, and in the proceedings of the Marylebone Vestry, various sanatory associations, and other public bodies," he is obnoxious to the charge of being actuated by motives of self-interest, in the discussion of the topics embraced by his Letters, but he protests manfully, that though not indifferent to the pecuniary advantages which may result from the success of his fluid, they hold but a very subordinate place in his regard compared with "the public good."

"I attach no selfish conditions to my suggestions, my Lord. I have not rested, nor do I seek to rest, their merit on those of *my* fluid exclusively. If a better or cheaper disinfectant than mine exists, or may yet be discovered, *I* can reap no benefit from the adoption of the suggestions contained in this letter; and if, as I unfeignedly believe, none can equal it in efficacy or economy, I assure your Lordship the public shall sustain no disadvantage from the monopoly my patent confers, but, on the contrary, shall be gainers from the circumstance, inasmuch as I shall thereby be enabled to furnish it at a lower price than would prove remunerative in transactions limited by competition."—p. 63.

He insists very fairly on the amount of "careful study," which he has been necessarily called upon, by his connection with the patent fluid in question, of devote to the subject of "improved sanatory regulations"—on the thorough knowledge he has acquired of "the lamentably imperfect sanatory arrangements existing in this country, and of the better systems (in many respects, at least,) instituted in some parts of the continent," as well as of the various plans of improvement which have been from time to time propounded by individuals and associations—and on the ability which he may be consequently presumed to possess, of saying something worth listening to on the "almost all-absorbing topic of the day"—sanitary reform.

The pamphlet itself, however, is the author's best apology. Although, of a truth, sprung of private interest, it has manifestly the public good for its permanent object, and cannot fail to be of public service. It presents some very striking views of the enormous evils inflicted on the community by the present defective system of drainage and sewerage, and some equally striking (though rather highly coloured) views of the benefits which might be derived, from combining with the removal of these evils, a due regard to the economical uses to which the waste matters of towns may be turned. The author writes with a degree of earnestness and fervour well calculated to fix attention and enlist support; in a style somewhat hasty and rambling to be sure, but which may be well excused, in consideration of the seasonableness with which the pamphlet makes its appearance at the present time.

Mr. Ellerman states that the matter of this pamphlet is intended to form part of "a more elaborate work" which he has in preparation; and that his reason for anticipating their appearance in that shape was the prevalence of a rumour, that the new Metropolitan Sanitary Commissioners have it in contemplation to consult only the public health, regardless of all collateral benefits.

"A very general impression is abroad that the Metropolitan Sanitary Commissioners are strongly of opinion that the principle of regarding all other economies as inferior to the economy of public health should be carried out to the fullest possible extent, even to the total sacrifice of the former. It is understood that the Commissioners will earnestly recommend that no portion of the sewage of London shall be suffered to accumulate or be collected anywhere, *but that the whole shall be constantly*

* Sanitary Reform and Agricultural Improvements; or, How to produce Health and Abundance. In Three Letters. By Charles F. Ellerman, Esq. Letter I.: Drainage, Sewerage, Urinaria, and Cloacæ. pp. 70. With Engravings. Pearce and Hyde.

projected into the Thames; and that, in order to prevent the possibility of noxious exhalations from the sewers, or the slightest accumulation of deposits therein, they shall be regularly flushed with large volumes of water at brief periodical intervals. It is further believed that the system thus devised for the metropolis will be prescribed for all other towns."

We see no reason for believing that the Commissioners entertain any such project. We think it very probable that they will recommend that no portion of the sewage of London shall be suffered to "accumulate or be collected any where" (within the Bills of *Mortality*); and if they only succeed in doing that, they will deserve the blessings of the people of London to the end of time. But that they will insist that "the whole shall be constantly projected *into the Thames*," seems to us rather a ridiculous supposition. All that they are likely to insist upon is, that the whole shall be removed somewhere or other with the least possible delay—which is quite right; and no doubt, every facility will be afforded for the purpose. If it can be carted away landward, good and well; but if not, then to the sea with it by all means. We may be certain that, if there were room for choice in the matter, the Thames, from which so large a portion of the metropolis draws its supply of water, would be the last place to which the Commissioners would think of consigning its refuse filth; but as there is no other reservoir or outlet for the sewers of London but the Thames, it remains for Mr. Ellerman to show how any method better than that of "flushing" could be adopted to keep these sewers in a clean and efficient state.

Mr. Ellerman undertakes an easy task when he proceeds to show that there is an immense mass of invaluable matter "now carried away by the sewers which might be converted into a valuable manure for agricultural purposes;" and that the more you neglect this matter, the more you lose. No one doubts this: it is a prejudice of the senses, rather than a conviction of the mind, which stands here in the way of improvement. Mr. Ellerman's statements on this head are worth noting, however, as showing what this prejudice of ours costs us. Mr. Smith, of Deanston, calculates the manure-producing power of each individual of the population as being equal to 1*l.* per annum. Mr. Chadwick and Dr. Playfair state, that in Belgium 1*l.* 17s. per individual is actually realized. According to Mr. Smith, therefore, the annual value of the human manure of Great Britain and Ireland must be equal to 28,000,000*l.* per annum; according to Messrs. Chadwick and Playfair, to 51,800,000*l.* Other estimates—to which, however, we cannot say we attach much value—carry the thing still higher. One makes the annual amount 181,644,531*l.*; another, to which Mr. Ellerman very much inclines, 104,590,754 ! ! !—more than the entire public revenue of the kingdom, with all the county and parochial rates into the bargain!—more than would have paid for all the foreign corn imported during the late scarcity!—more than would convert thirty millions of acres of waste lands into luxuriant corn-fields! Of this vast source of wealth—vast in any view which can be taken of the case—by much the greater part is wholly sacrificed:

"The major portion, perhaps, as in London, is discharged into our rivers and harbours; another large portion is suffered to accumulate and waste in cesspools rarely emptied; and the residue—that of which cesspools are unavoidably relieved because they will contain no more, and that which is removed because the nuisance it creates is found to be intolerable—is so greatly deteriorated in quality and enhanced in expense, by the adulterating substances employed to render it portable, as to prove almost profitless."

The plan which Mr. Ellerman proposes to obviate this waste is as follows:

"Assuming that all habitations are furnished with properly-constructed water-closets, as the first step; I propose that the pipes from such closets shall communicate with tubular glass or earthenware pipes of larger diameter, which shall discharge themselves into covered tanks of ample dimensions. It will, of course, be necessary so to construct these tanks that they shall not permit the escape of any of the liquid portion of their contents into the surrounding soil; and this may be effectually accomplished by cementing them, or using asphaltum. The tanks may be situated in the open spaces formed by the junction of several streets; and I would suggest that each be limited to the exuviæ of the inhabitants of a small area—say four or six streets, in some instances, and rather more where the

streets are less and nearer together. There would be no difficulty in constructing tanks sufficiently capacious to permit one to receive the nightsoil and urine of an entire town; and one such tank would probably cost lest to construct than a number of smaller tanks of equal aggregate dimensions. But more numerous tanks of inferior capacity are preferable on many accounts, more especially from considerations of economy in the construction of the sewers connected with them. The major portion of the cost of laying sewers throughout a large town arises from the varying levels of the ground upon which it stands. Where there is an undulating surface, the excavations for the sewers have to be very deep in the higher parts, in order to attain the level suited to the lower ones; and excavations of such depth are attended with enormous expense and inconvenience, and not unfrequent peril to life or property. Moreover, where the discharges from habitations extending over a large area are conveyed by one sewer, its necessarily increased dimensions must greatly enhance the expense of its construction, and the liability to accumulations of deposit, as well as requiring it to be composed of materials having a greater tendency to permit escape of the contents. I should extend this letter beyond due limit, were I to cite the numerous evidences whereby this fact may be shown; I must therefore beg to refer your Lordship to the valuable and conclusive information upon this point, which appears in the 'First Report of the Metropolitan Sanatory Commissioners,' who have exclusively devoted several important pages to it. By having numerous tanks, it will be unnecessary to make deep excavations for the sewers; and the quantity of matter discharged into each tank will be sufficiently small to admit of using glass or earthenware tubing of moderate diameter, instead of more huge, costly, and otherwise objectionable brick culverts. Besides, by thus limiting the cloacæ sewers to small areas, and thereby enabling them to be near the surface of the ground in all situations, it will be easy to provide against an insufficient declination of the tubes. inasmuch as a great uniform fall may be attained in sewer courses of short length, without the final extremity being far beneath the surface: they will also be easier and cheaper of access when repairs are required. I propose that the substances received into these sewers and tanks shall be restricted, with one or two exceptions which I will hereafter specify, to the matter from water-closets and chamber-utensils, and the discharge from public urinals, the fluid portion whereof will be found amply sufficient to ensure a rapid and complete transit of the matter through sewers of the form and declination practicable under this plan. In order, however, to make assurance doubly sure, in respect of the prompt and thorough transit of the matter through the sewer tubes, it may be contrived that intermediate cisterns shall be constructed in connection with each public urinal, wherein the liquid may be suffered to accumulate during twenty-four hours, or some adequate given period, when it may be discharged into the sewers in a sufficient volume to flush them most effectually."

A needful supplement to this plan is some means of rendering the matter inodorous while in the course of collection; and so the Ellerman pamphlet introduces us in the most natural way possible, to the Ellerman specific. Three modes are described by which it may be applied.

"I suggest, then, that the matter discharged into the proposed tanks shall be deodorised in the onset. There are three modes by which this may be very simply effected. One is by fixing small cisterns, constantly containing the deodorising fluid, in each water-closet, and contriving that a small portion shall be discharged into the soil-pan every time the machinery connected therewith is set in motion. A second mode is that of attaching fluid cisterns to each of the public urinals, and causing the fluid so placed to dribble continually into the urine channels. And the third method is that of discharging certain quantities of the fluid at frequent stated invervals directly into the tanks. All circumstances considered, the best plan, perhaps, will be that of administering the fluid in duly-regulated quantities at the urinals, subject to periodical examination of the tanks, with a view to ascertaining and supplying any deficiency. It would unquestionably be advantageous to apply it in every water-closet, since that would be an effectual means of preventing the slightest smell in those places; and there can be no doubt that householders who are disposed to avail themselves of every means of preventing nuisances, would cheerfully consent to use deodorants in their water-closets. But it would not, perhaps, be advisable to depend upon all householders acting thus; inasmuch as carelessness, indifference to cleanliness, or motives parsimony, would probably cause too many of them to neglect to keep the fluid cisterns duly supplied. Moreover, the expense of placing these cisterns (which should be composed of glass or earthenware) in every house, though trifling, might prove a source of objection, in many quarters, to this mode of applying the deodorising fluid.

It is possible, however, to obviate these obstacles to applying the fluids in the water-closets, by means of a probable provision of the intended Sanatory Bill; viz., by the appointment of public officers to act as inspectors of nuisances, who shall, among other duties, occasionally inspect the cloacæ, drains, dust-bins, &c., of private dwellings. These officers might have power to enforce the constant application of the fluid. Indeed, the sanatory authorities themselves might provide it, and be repaid from the proceeds of the night-soil," &c.

Mr. Ellerman recommends that the pipes should be of "*glass* or earthenware;" his reason, no doubt, being, that they are not so liable to be affected by acids as metal pipes. When, a few years ago, Sir Robert Peel proposed to Parliament the abolition of the duties on glass, he insisted much on the superiority of glass pipes for the conveyance of water and gas through the streets; and referred to the use which had been made of them, in that way, in Paris. We have never, however, met with any person who could say that he had actually seen such pipes in Paris; and not a few Englishmen have to our knowledge explored Paris in vain in the search after them. Sir Robert Peel was assuredly misinformed: the French have been always as much strangers as ourselves to the use of glass pipes for such purposes. Even when the abolition of the English duty on glass set this branch of manufacture free, and threw it open to inventive enterprise, it was for a long time found much easier to talk of laying down glass pipes in our streets, than to discover the way of making them. Pipes of such length as the iron tubes in ordinary use—namely, from 9 to 12 feet—were things quite beyond the glassman's art, as well in England as France; indeed, it was not till towards the end of the last year that a mode of making such pipes was found out by Mr. Coathupe, of the Nailsa Works, near Bristol,—a discovery very opportune for Mr. Ellerman and his plans, and to which we gladly take this opportunity of drawing general attention. Mr. Coathupe produces pipes of all lengths, not exceeding 12 feet, of a very uniform bore, and of any required thickness of metal.

To return to the Ellerman fluid:—It may be said, and has been said, that to deodorise is not to disinfect Mr. Ellerman meets this objection in this way:

"If it be true that the sense of smell with which an all-wise Providence has endowed us is given, among other purposes, in order to warn us against miasmatic exhalations; and if it be also true that aught which depresses the human system predisposes it to contract disease, and that powerful odours have this depressing effect in a large degree (facts which have never been disputed), I am at a loss to discover upon what grounds it can for a single moment be reasonably contended that deodorants are not necessarily disinfectants. To me it appears that the terms deodorising and disinfecting, as applied to baneful odorous gases, are synonymous; and that to use either in any other sense is to attempt a distinction without a difference. I have always been led to conclude that the destruction of the offensive smell of the noxious gases arising from decomposing substances, constitutes sufficiently conclusive evidence that that which is inimical to health is destroyed; and in this opinion I am remarkably confirmed by a gentleman who, though not himself a medical man, has had greater opportunities than almost any other individual of collecting the opinions of the most eminent members of the medical profession. In the course of the evidence before the Select Committee of the House of Commons, from which I have already made quotations, Mr. Edwin Chadwick says—

"'All my experience, and all my information, go to vindicate the integrity of the nose—that if you did not smell it' (sewage) 'at any place, there would be no injury from it; and if you did, there would. * * * There are two doctrines which I think these conclusions, and my own investigations, would establish: one is in respect to the sanatory condition of towns, that all smell is, if it be intense, immediate acute disease, and eventually we may say that, by depressing the system, and rendering it susceptible to the action of other causes, all smell is disease; and I think the other conclusion will be established as to agricultural districts, that all smell of decomposing matter may be said to indicate the loss of money.'"

Mr. Ellerman has overlooked a very obvious flaw in this argument. You may deodorize a particular substance—make the odour natural to it imperceptible; but it does not follow that you will thereby destroy the peculiar principle to which that odour is owing. It may still exist, though you can no longer perceive it. It may have been merely deprived by your deodorizing agent of its power of acting on your olfactory organs—reduced to a state in which, though you cannot

smell it, you cannot be sure of its not exercising as injurious an effect as ever on your health; just in the same way as you may decolorize a column of smoke loaded with noxious vapours, without rendering it thereby the less noxious. Indeed, if we were disposed to press this point against Mr. Ellerman, we might say that, since "the sense of smell with which an all-wise Providence has endowed us is given, among other purposes, in order to warn us against maismatic exhalations," you, Mr. Ellerman, are warring against nature, in introducing the use of a fluid, which may make it impossible for the sense of smell to detect the presence of such exhalations. We do not, however, go so far as this; for we imagine it to be a very possible thing to spare the nose a good deal, without at all damaging the interests placed under its guardianship. All that we would urge on this head is, that we should beware of falling into the mistake, encouraged by the course of argument pursued by Mr. Ellerman, of supposing that absence of smell is necessarily identical with absence of poison, and that we should take precisely the same steps for ensuring perfect cleanliness and salubrity—by abundant watering and flushing, for example—as if the smell had not been removed at all.

We are gratified at the same time to observe from the testimonies adduced by Mr. Ellerman, that there are strong grounds for believing that his fluid does disinfect (a term which we use, after the fashion of the day, to express the distruction of putrefactive exhalations, though it is by no means strictly appropriate) as well as deodorise. We give at length a report of some experiments made with the fluid by Dr. Ure and Mr. Scanlan, which is in the highest degree satisfactory:

"Report of Experimental Researches and Observations upon the Patent Deodorising Liquid of Mr. Charles F. Ellerman, compared with the Patent Liquids of Sir William Burnett and M. Ledoyen, for the same Purpose. By Andrew Ure, M.D., F.R S., and Mr. Maurice Scanlan, Manufacturing Chemist, and Member of the Chemical Society

"London, January 16, 1848.

"Having subjected measured quantities of most fetid semi-fluid night-soil to the action of the said three patented preparations, we have found:

"1. That the solution of nitrate of lead prescribed by M. Ledoyen is far less powerful than the other two preparations; on which account, as well as from its poisonous nature and high price, it cannot be advantageously employed as a destroyer of offensive putrid odour, or disinfector.

"2. We find the solution of chloride of zinc of Sir William Burnett to possess considerable deodorising power, though certainly not equal to that of Mr. Ellerman, used in like proportion; and as that chloride is a poisonous substance, and ten times dearer than Mr. Ellerman's liquid of superior efficacy, it cannot come into competition with Mr. Ellerman's, in reference to the comfort and health of the public.

"3. Mr. Ellerman's preparation is not specified, but we know its composition, and are free to declare, that it is chemically qualified to decompose or condense sulphuretted and phosphuretted hydrogen, as well as the cyanic compounds, which may be regarded as the most noxious and offensive aëriform products of putrefying animal and vegetable matters.

"We are further of opinion, that, since fœtor causes sickness, nausea, vomiting, and other morbid affections, its abatement or destruction by the use of Mr. Ellerman's fluid will unquestionably operate beneficially in counteracting contagion and promoting the health of towns.

"We, therefore, can conscientiously recommend its extensive adoption to to all Sanitary Commissioners, to their subordinate agents, to philanthropic societies, and to private families.

"In itself it is not poisonous, nor is it at all likely to produce any injurious effects, either intentionally or by mistake.

"Mr. Ellerman's fluid does not destroy the efficacy of the phosphates in night-soil for agricultural purposes.

(Signed) "Andrew Ure.
Maurice Scanlan."

Mr. Ellerman proposes two or three other sanatory measures, in addition to, and "irrespective of his deodorizing process." He would place in the aperture of each of his receiving tanks the effluvia-trap, invented by Mr. Walker, and which we noticed with commendation some time ago (vol. xlvi., p. 204). "If it were possible for any smell to arise from the tanks, notwithstanding the application of the deodorizing liquid, this simple invention would effectually confine it." And he recommends, that an air-tight nightsoil cart, recently registered by Messrs. Dean, Dray, and Dean, should be employed to carry away the nightsoil from the tanks:

"By means of this apparatus, the contents of a tank may be discharged at once into the cart or wagon (from which no effluvia can escape) by one man's labour, and removed to the spot whence it is finally transported to the land. The power of the pumps attached to these carts, and the capacity of the hose, is such that a tank of great dimensions may be emptied by them in a very short space of time. The operation, therefore, might readily be confined to such hours of the night, or early morning, as would effectually guard against obstruction of the streets or thoroughfares in which the tanks are situated."

The cart here referred to is constructed on the exhausting principle. The body

of the cart consists of an air-tight box, to one end of which is fitted an air-pump, and to the other a stand pipe, to which is attached a flexible pipe with metallic nozzle. When this cart is to be used, the nozzle is inserted among the semi-fluid matter in the tank, and the air-pump set to work, which, exhausting the air in the box, pipe, and tube, causes the matter to ascend the hose and pass over through the stand pipe into the box, until it is full.

Mr. Ellerman illustrates his plans by a plate, of the principal portion of which the engraving prefixed to the present notice is a copy. A, represents one of his proposed tanks; B B, the glass sewer pipes; C C, one of the sewer supply-pipes; D, the water-closet; E, the deodorizing fluid cistern; F, Walker's effluvia-trap; G, the hose leading from one of Dean, Dray, and Dean's carts through the trap into the tank; and H, the air-pump.

It will be observed, that by Mr. Ellerman's arrangements any excessive dilution of the contents of the tanks is effectually guarded against. The more concentrated they are, of course the better; not only more easy to remove, but of more value when they reach their points of destination:

"In most instances facilities for water transit exist, which will render it unnecessary to concentrate the matter more highly; inasmuch as it may be conveyed in barges and other vessels in the state it is received from the tanks. In instances wherein it may be necessary to resort to land transit for any considerable distance, perhaps it may be advisable to suffer it to undergo a prior process extensively adopted in France and elsewhere; viz., conversion into inodorous *poudrette*. This useful process, too, its highly concentrated condition will greatly facilitate; and the drying has only to be performed by a process which forms part of my patent, or by the ingenious apparatus and method devised and patented by Dr. Ayre, to be effected very speedily and without any diminution of the fertilising principles. The weight will then be comparatively so small, and the form of the matter so completely inoffensive, that it may be packed and conveyed by railway, or other land carriage, as guano is, without inconvenience and at a moderate cost. The manufacture of *poudrette*, too, may be found advantageous for other purposes than that of rendering the manure more portable. In a pulverised form the fertilising matter may be equally distributed in the soil by means of drills, under circumstances which render this mode of applying it peculiarly beneficial."

The plan of Dr. Ayres, to which reference is here made, was fully described in our current vol. p. 5. It is highly creditable to the candour of Mr. Ellerman that he speaks so well of a plan which may be considered in one respect as a rival to his own.

Mr. Ellerman concludes with claiming for his system "a fair trial on an experimental scale, say in some provincial town at present without public drains or sewers of any kind, or in a limited district of the metropolis;" and this we think it well deserves.

ON THE CONSTRUCTION AND VENTILATION OF SEWERS. BY WILLIAM DREDGE, ESQ., C.E.

(Continued from page 127.)

It would be easy to prove the truth of the preceding remarks by actual experiment. A tube may be carried from the crown of a sewer and attached to a barometer, and the effects produced on the rise of the mercurial column observed. I apprehend that a registry of the mechanical pressure of the gas obtained by this means would much assist in directing the effectual ventilation of sewers. The value of this registry would be greatly enhanced by knowing the corresponding temperature in the drains, so that it would be advantageous to place a thermometer alongside of the barometer above mentioned; and as the ordinary thermometer would not be applicable for this purpose, I would suggest one of the following form as better adapted:—Fix a thin metal tube of any considerable length, say 30 or 40 feet, and of known capacity, along the crown ot the sewer; let the tube be hermetically sealed at one end and brought through the crown of the sewer, and attached *perfectly* air-tight to a barometer at the other. This tube, when filled with air, at the ordinary temperature of 50°, would cause a pressure of 15 lbs. per square inch on the mercury, and balance a column approaching to 30 inches. When the temperature in the sewer exceeded 50°, the air in the tube would expand, and in proportion to the

Fig. 6.

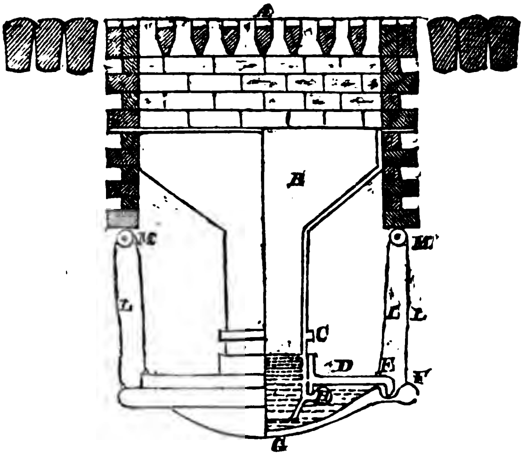


Fig. 7.

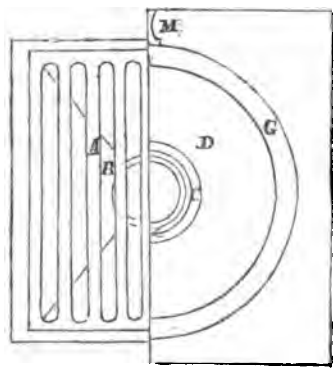
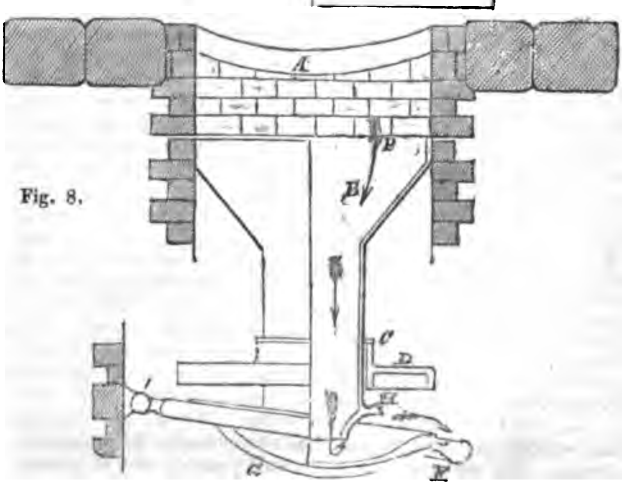


Fig. 8.



heat in the sewer would be the elastic force of the air in the tube, and the consequent rise in the mercurial column would register the temperature.

I do not suppose that in a drain *properly ventilated* the elastic force of the noxious gases would greatly exceed the atmospheric pressure; and, therefore, the present form of trap, except in some instances, *may* be found sufficient. At all events, it is most probable that if the water were increased in depth, and the trap were sealed with the hydrostatic pressure of 8 or 10 instead of 3 or 4 inches of water, that the sealing would not be broken. I have, however, in what follows, proposed some new plans of traps to prevent the effluvia from arising.

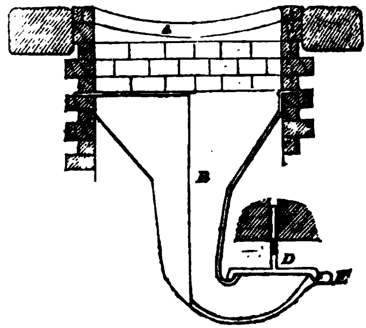
Figures 6, 7, and 8, are engravings of a trap. Fig. 6 is a vertical section of the trap; fig. 7 is a plan; and fig. 8, a vertical section; which last figure shows the trap in operation.

A, is the grating; B, the cast metal body of the trap; C and H rims cast on the body, of the form and in the position represented; G, the basin for holding the water to seal the trap; round the basin, is the hollow rim F. D, is a valve or cover to the basin, the edges, E and K, of which, when shut down, fit into the grooves F and H. The ropes L and L are attached to the basin at E, and the cover at E passing over the pulleys M M.

When the water passing through the grating flows in the direction of the arrows, into the closed basin, G, it lifts, by reason of the superincumbent pressure, the cover, and depresses the basin G, which, to facilitate the discharge of mud and silt, is attached on one side to the hinge, I, which causes it to tip aside, (as seen in fig. 8.)

Figure 9, shows another form of trap and cover in which the cords, L L, are dispensed with. The water in this case acts by its upward pressure.

Fig. 9.

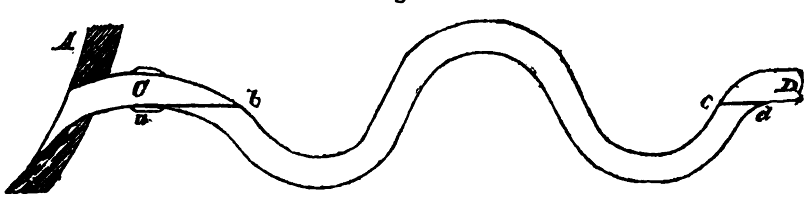


It will be observed that from the construction of the basin the grooves round the lip must fill with water, and when the cover, D, again descends into its position, it forms a perfect water-joint.

The objects proposed by the adoption of this cover or valve, D, are, *first*, to lessen the evaporation of the water during long droughts; *second*, to prevent the gases issuing from the sewers from contaminating the water sealing the trap; *third*, and principally, to prevent the elastic forces of the gases from the sewer, acting upon the surface of the water in the basin, destroying the equilibrium of the column of water which seals the trap.

Figure 10, represents a trap for house drains, in which I propose to give a curvilinear direction to the discharge-pipe, as represented in the figure. This form would not at all impede the flow into the main drain, for if the pipe were in one piece from C to D, so that the external air could not penetrate it to prevent its acting upon the principle of the syphon,

Fig. 10.

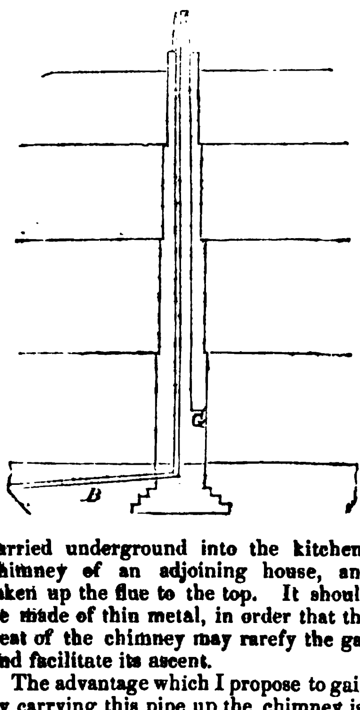


it would always maintain itself full, and the flow would be proportionate to the excess of the level *cd* above *ab*.

No vermin could find their way from the main drain through a trap of this form; neither could any noxious gas from the drain penetrate through such a length of pipe filled with water to the level of the drain; nor would any difference that may exist between the elastic pressure of the gas in the drain and the atmospheric pressure, at all impair its efficiency.

Figure 11, is a sketch of a plan for ventilating a sewer. The pipe B, with a funnel-shaped mouth, is built into the crown of the sewer. This pipe is

Fig. 11.



carried underground into the kitchen-chimney of an adjoining house, and taken up the flue to the top. It should be made of thin metal, in order that the heat of the chimney may rarefy the gas and facilitate its ascent.

The advantage which I propose to gain by carrying this pipe up the chimney is, that the temperature there would give a preponderance to the gas issuing in that direction in preference to any other. It now more frequently passes through the house, to the great annoyance of the people residing therein.

I do not anticipate that by putting a pipe outside the house, parallel or identical with the rainwater-pipes, it would have the full effect desired, and for this reason—on cold frosty nights there is frequently a difference between the external and internal temperature of from 30° to 40°, which would greatly rarefy the air within the house, and give the gases a tendency to pass off in that direction.

(*To be continued.*)

MATHEMATICAL PERIODICALS.

(Continued from page 84.)

V.—*The Gentlemans' Mathematical Companion.*

Origin.—This periodical was begun in the year 1797, and was announced as a "*Companion to the Gentlemans' Diary*," under which title the first number was published. The Rev. Charles Wildbore, then editor of the *Diary*, it appears, disapproved of the work, and stated, in the *Diary* for 1798, that he "would discourage it all in his power;" the next number was, in consequence, issued under the name of "*The Gentlemans' Mathematical Companion*," to which the title of the first number was made to correspond on its being reprinted in 1809. The work was completed in thirty annual numbers, the last being for the year 1827.

Editors.—Mr. William Davis, Member of the London Mathematical and Philosophical Society, A. D., 1797—1807. Mr. John Hampshire, A. D. 1808—1826.

Contents.—The first number contained a selection of papers from the "Philosophical Transactions, by Drs. Pemberton, Vince, &c.; new enigmas, charades, rebuses, queries and mathematical questions for solution. The succeeding numbers contained answers to the enigmas, &c., of the preceding year; new questions, &c., proposed for solution, and concluded with a selection of mathematical papers extracted from "valuable and scarce scientific works," together with many "original communications." Among the former are extracts from the writings of Burrow, Halley, Horsley, Hellins, Ivory, Lambton, Landen, Leslie, Maseres, Maskelyne, Milner, Pemberton, Vince, Wallace, Wales, and Young. In the latter are valuable papers by Baines, Beta, Cygni, Cunliffe, Farey, Noble, Nicholson, Omicron, Rotherham, Scott, Shires, Slee, Smith, Todd, &c. So rich and varied a selection from such distinguished writers deserves more par-

ticular notice than a bare enumeration of names; and, agreeably to the suggestion of my esteemed friend, Professor Davies, of the Royal Military Academy, I proceed to give the "bill of fare," which, no doubt, will prove highly satisfactory to the appetite of the most epicurean mathematician.

Extracted Papers.

Art. I. Kepler's Methods of Computing the Moon's Parallaxes in Solar Eclipses Demonstrated and Extended. By Dr. Pemberton: *Phil. Trans.*

II. Observations on the Fundamental Property of the Lever; with a Proof of the Principle assumed by Archimedes in his Demonstration. By the Rev. S. Vince: *Phil. Trans.*

*** See question 1648 *Ladies' Diary*, 1839, 40, on the subject of this paper.

III. A Problem in "Mercator's Navigation," viz., "A ship sails from a given latitude, and having sailed a certain number of miles, has altered her longitude by a given quantiiy, to find the course steered." Proposed by Dr. Halley, resolved by Israel Lyons: *Phil. Trans.*

IV. Considerations on Logarithmic Solar Tables for finding the Latitude at Sea. By Dr. Pemberton: *Phil. Trans.*

*** This paper contains the demonstration of a neat property of lines in a circle, in connection with the ancient geometrical method of conducting spherical inquiries.

V. A Discourse on the Locus for Three and Four Lines, celebrated among the Ancient Geometers. By Dr. Pemberton: *Phil. Trans.*

*** In a scholium appended to this valuable paper are several propositions of Apollonius's "*De Sectione Determinata,*" elegantly demonstrated; and the writer also adds a postscript, in which he considers the problems:

1. To draw a triangle given in species, that two of its angles may touch each a right line given in position, and the third angle or given point.

2. To find the place of the earth in the ecliptic, whence a planet in any given point of its orbit shall appear stationary in longitude.

VI. Concise Rules for Computing the Effects of Refraction and Parallax, and for Computing the Distance of the Moon from a Star. By Dr. Maskelyne: *Phil. Trans.*

VII. Hints Relative to Friction in Mechanics. By Reuben Burrow: *Asiatic Res.*

VIII. On the Motion of Bodies Affected by Friction. By the Rev. Samuel Vince: *Phil. Trans.*

*** Two valuable papers, and well worthy of being more generally known.

IX. An Easy and General Method of Solving all the Cases of Plane and Spherical Triangles. By the Rev. Walter Fisher: *Edin Phil Trans.*

X. Geometrical Solutions of Three Celebrated Astronomical Problems, viz.

1. To find in the ecliptic the point of longest ascension.

2. To find when the arc of the ecliptic differs most from its oblique ascension.

3. The tropic found without the aid of the parabola. By Dr. Pemberton: *Phil. Trans.*

*** A very valuable specimen of the methods by which the ancient geometers conducted their astronomical inquiries.

T. W.

(*To be continued.*)

*** *Correction.*—In page 96, col. 2, line 31, *for* 1842, *read* 1840; and in line 32, *for* 1843, *read* 1841. I am indebted for this correction to my friend Mr. Stephen Fenwick, of the Royal Military Academy. Professor Davies also states that Non Sibi and N. Selwon, of the *Liverpool Student*, are fictitious names assumed by Mr. Knowles, of the same publication.

Thomas Wilkinson.

Burnley, Feb. 8th, 1848.

Veneering Machine.—We have received from the inventor, Mr. John Dresser, of Stockbridge, Mass., a drawing and description of an excellent machine recently invented and put in operation, for cutting veneers from a round log, and that without any other waste or loss of timber than what is occasioned by reducing the log to a round form, and a small core in the centre. From a single log of bird's-eye maple, 3 feet long and 20 inches in diameter, the machine will cut a single and perfect sheet of beautiful veneer, (a sample of which may be seen at this office) 3 feet wide and 300 feet in length, measuring 900 feet. The operation of cutting these veneers is so rapid as to keep a surveyor constantly employed in measuring the sheets. It may be understood that the log revolves on its axis, while the knife or cutter is nearly stationary, but moves gradually towards the centre of the log at the rate of a sixteenth of an inch to each revolution of the log.—*Scientific American.* This mode of cutting veneers is not unknown to this country; though we believe it has never been carried to such an extent as Mr. Dresser has done. There used to be exhibited at the Polytechnic Institution, and perhaps is still, a specimen of ivory, 17 inches by 38, cut in this manner by a Mr. Papé, of Paris.—Ed. M. M.

A TABLE FOR FINDING THE NUMBERS CORRESPONDING TO LOGARITHMS OF TWELVE OR ANY LESS NUMBER OF PLACES. BY PETER GRAY, ESQ., F.R.A.S.

In the *Mathematician* for November, 1845, appeared a paper by Mr. Weddle, then of Newcastle, and now of Wimbledon, Surrey, on the Computation of Logarithms and Anti-logarithms. The methods there unfolded, especially the first—the logarithmic method—far transcended in utility any that had been previously proposed for like purposes. In the *Mechanics' Magazine* for November, 1846, I gave an account of those methods, including various modifications by which I believe their utility was increased, and a new and more extensive Table, by the use of which the labour requisite for their application was materially diminished. In the *Mathematician* for March, 1847, appeared a paper on the same subject, by Mr. Hearn, containing also a logarithmic and an anti-logarithmic method. Of Mr. Hearn's anti-logarithmic method I shall speak presently: but in the meantime I have to remark of his logarithmic method, that it is absolutely identical with Mr. Weddle's. Mr. Hearn can hardly have been ignorant of Mr. Weddle's paper, for he has been a contributor to the *Mathematician* from a date certainly anterior to November, 1845; and the very number of that work in which Mr. Weddle's paper appears, contains also a paper by Mr. Hearn;—and that he was not ignorant of my papers, I infer from his having appropriated the title—a somewhat peculiar one—which I had prefixed to them, and also adopted certain of the modifications of the logarithmic method which I had proposed. And yet Mr. Hearn makes no mention in his paper of either Mr. Weddle or myself. In these circumstances, it appears to me that Mr. Hearn's conduct can hardly be characterized as other than a piece of petty literary larceny, quite unworthy of a gentleman of his talents and standing. He seems to have yet to learn that this unscrupulous mode of dealing with the rights of others is about the most efficient he could adopt, if his object were to have his own rights called in question. When one result put forth by a writer as his own is found to have been appropriated from another, a suspicion *will* arise that more of his results may be entitled to be placed in the same category.

I must express my surprise also that the respectable editors of the *Mathematician* gave admission to Mr. Hearn's paper without remark: their doing so seems to evidence a degree of indifference to the rights of their contributors which I should think but ill calculated to promote the interests of their work.

Mr. Hearn's anti-logarithmic method, so far as I am aware, is his own. Unlike Mr. Weddle's, it requires a different table from the logarithmic method for its application. But, this disadvantage once surmounted by the construction of the table, it possesses advantages in other respects which entitle it to attention. I therefore now present it to the readers of the *Mechanics' Magazine*, with a new table of ten times the extent of the table given by Mr. Hearn, and commensurate with that which I formerly gave for the application of Mr. Weddle's methods.

The table consists of four columns, the first three headed I., II., III., respectively, and the fourth headed IV. V. VI. The meaning of the last heading is, that column V. is the same as column IV., with two places cut off, and column VI. the same, with four places cut off. The values in the table are logarithms of twelve places, deficiencies being supplied by cyphers prefixed. The logarithms in the first column are those of 101, 102, . . . 199; in the second column those of 10001, 10002, . . . 10099; the third those of 1000001, 1000002, . . . 1000099, and so on; and the relation to those numbers of the figures in the argument columns will be apparent on inspection. There is also an auxiliary table, containing the logarithms of the first nine natural numbers.

The principle of the operation for applying this table admits of easy explanation; but the details will be best understood by reference to examples. The given logarithm is decomposed by subtraction into a series of other logarithms taken from the successive columns of the table, commencing, if circumstances admit of it, with the auxiliary table. The numbers corresponding to these logarithms being then multiplied together, the product is the number required.

In this process, unlike the analogous one of Mr. Weddle's, there can arise no *failing case.* Although a column may

occasionally have to be passed over, (which is no disadvantage,) it can never be necessary to make two entries in the same column. The distinguishing characteristic of this method arises, as will be presently seen, from the peculiar form of the factors whose logarithms are tabulated. In consequence of this peculiarity of form, the operation of multiplying these factors becomes one of extreme facility.

Example 1.

Required the number whose logarithm is 0·94011,63078,18,

```
940116307818|
845098040014|7
------------
 95018267804|
 93421685162|24, Col. I.
 -----------
  1596582642|
  1560652643|36  ,,  II.
 -----------
    35929999|
    35610688|82  ,,  III.
    --------
      319311|
      317035|73  ,,  IV.
      ------
        2276|
        2258|52  ,,  V.
        ----
          18|
          18|42  ,,  VI.
          --

7 0 0 0 0 0 0 0 0 0,0,0|24
1 4 0 0 0 0 0 0 0 0 0 0|
  2 8 0 0 0 0 0 0 0 0 0|
-----------------------
8 6 8 0 0 0 0 0,0,0 0 0|36
      2 6 0 4 0 0 0 0 0|
        5 2 0 8 0 0 0 0|
-----------------------
8 7 1 1 2 4,8,0 0 0 0 0|82
          6 9 6 8 9 9 8 4|
            1 7 4 2 2 5 0|
-----------------------
8 7 1 1,9,6 2 3 2 2 3 4|73
              6 0 9 8 3 7|
                2 6 1 3 6|
-----------------------
8 7,1,1 9 6 8 6 8 2 0 7|52
                  4 3 5 6|
                    1 7 4|
-----------------------
,8,7 1 1 9 6 8 7 2 7 3 7|42
                      3 5|
                        2|
-----------------------
8.7 1 1 9 6 8 7 2 7 7 4|=Number req.
```

In the first part of this operation the given logarithm is seen to be exhausted by successive entries of the auxiliary table and the several columns of the principal table; and the factors whose multiplication will produce the number required are $7 \times 124 \times 10036 \times 100082$, &c. The multiplication of these factors is shown in the second part of the operation. The first factor, 7, is set down, followed by 11 cyphers. One cypher is pointed off, and multiplication made by 2; another cypher is pointed off, and multiplication made by 4. The three lines are then added, forming a new multiplicand. Three figures are now pointed off, and multiplication performed by 3; another figure is pointed off, and multiplication performed by 6, and the three lines are again added. This process is repeated till all the factorial figures have been used, and the last sum is the number required.

But the last process may be much abbreviated, as here shown.

```
7                   |
1 4                 |2
  2 8               |4
---
8 6 8
    2 6 0 4         |3
      5 2 0 8       |6
-----------
8 7 1 1 2 4,8
          6 9 689984|8
           1 742250|2
-------------------
,8,7,1,1,9,6 232234|
             609837|7
            · 26136|3
               4356|5
                174|2
                 35|4
                  2|2
-------------------
8,7 1 1 9 6 872774|
```

1. The placing of the several products is regulated as follows:—The first product falls one place to the right of its multiplicand, and the second two places to the right of the same; the third product falls three places to the right of *its* multiplicand, and the fourth four places to the right of the same, and so on. The last figure of the fifth product thus falls in the twelfth place, and hence the multiplicand for the sixth product is the third multiplicand with the last figure cut off. From this point the curtailment of the multiplicand goes on regularly.

	I.	II.	III.	IV. V. VI.	
01	43 2137 3783	4342 7277	43 4294	4343	01
02	86 0017 1762	8685 0212	86 8588	8686	02
03	128 3722 4705	1 3026 8805	130 2881	1 3029	03
04	170 3333 9299	1 7368 3058	173 7174	1 7372	04
05	211 8929 9070	2 1709 2972	217 1467	2 1715	05
06	253 0586 5265	2 6049 8547	260 5759	2 6058	06
07	293 8377 7685	3 0389 9785	304 0051	3 0401	07
08	334 2375 5487	3 4729 6685	347 4342	3 4744	08
09	374 2649 7941	3 9068 9250	390 8633	3 9087	09
10	413 9268 5158	4 3407 7479	434 2923	4 3429	10
11	453 2297 8787	4 7746 1374	477 7213	4 7772	11
12	492 1802 2670	5 2084 0936	521 1503	5 2115	12
13	530 7844 3483	5 6421 6165	564 5792	5 6458	13
14	569 0485 1336	6 0758 7063	608 0080	6 0801	14
15	606 9784 0354	6 5095 3630	651 4368	6 5144	15
16	644 5798 9227	6 9431 5866	694 8656	6 9487	16
17	681 8586 1746	7 3767 3774	738 2943	7 3830	17
18	718 8200 7306	7 8102 7353	781 7230	7 8173	18
19	755 4696 1393	8 2437 6606	825 1517	8 2516	19
20	791 8124 6048	8 6772 1531	868 5803	8 6859	20
21	827 8537 0316	9 1106 2131	912 0088	9 1202	21
22	863 5983 0675	9 5439 8406	955 4374	9 5545	22
23	899 0511 1439	9 9773 0358	998 8658	9 9888	23
24	934 2168 5162	10 4105 7986	1042 2942	10 4231	24
25	969 1001 3008	10 8438 1292	1085 7226	10 8574	25
26	1003 7054 5118	11 2770 0277	1129 1510	11 2917	26
27	1038 0372 0956	11 7101 4941	1172 5793	11 7259	27
28	1072 0996 9648	12 1432 5286	1216 0075	12 1602	28
29	1105 8971 0299	12 5763 1312	1259 4357	12 5945	29
30	1139 4335 2307	13 0093 3020	1302 8639	13 0288	30
31	1172 7129 5656	13 4423 0412	1346 2920	13 4631	31
32	1205 7393 1206	13 8752 3487	1389 7201	13 8974	32
33	1238 5164 0967	14 3081 2246	1433 1481	14 3317	33
34	1271 0479 8365	14 7409 6692	1476 5761	14 7660	34
35	1303 3376 8495	15 1737 6823	1520 0041	15 2003	35
36	1335 3890 8370	15 6065 2643	1563 4320	15 6346	36
37	1367 2056 7156	16 0392 4150	1606 8599	16 0689	37
38	1398 7908 6401	16 4719 1346	1650 2877	16 5032	38
39	1430 1480 0254	16 9045 4232	1693 7154	16 9375	39
40	1461 2803 5678	17 3371 2809	1737 1432	17 3718	40
41	1492 1911 2655	17 7696 7077	1780 5709	17 8061	41
42	1522 8834 4383	18 2021 7038	1823 9985	18 2404	42
43	1553 3603 7465	18 6346 2693	1867 4261	18 6747	43
44	1583 6249 2095	19 0670 4041	1910 8537	19 1090	44
45	1613 6800 2235	19 4994 1084	1954 2812	19 5432	45
46	1643 5285 5784	19 9317 3824	1997 7087	19 9775	46
47	1673 1733 4748	20 3640 2260	2041 1361	20 4118	47
48	1702 6171 5395	20 7962 6393	2084 5635	20 8461	48
49	1731 8626 8412	21 2284 6225	2127 9908	21 2804	49
50	1760 9125 9056	21 6606 1757	2171 4181	21 7147	50

	I.	II.	III.	IV. V. VI.	
51	1789 7694 7293	22 0927 2988	2214 8454	22 1490	51
52	1818 4358 7945	22 5247 9921	2258 2726	22 5833	52
53	1846 9143 0818	22 9568 2555	2301 6998	23 0176	53
54	1875 2072 0836	23 3888 0892	2345 1269	23 4519	54
55	1903 3169 8170	23 8207 4933	2388 5540	23 8862	55
56	1931 2459 8354	24 2526 4678	2431 9810	24 3205	56
57	1958 9965 2409	24 6845 0128	2475 4080	24 7548	57
58	1986 5708 6954	25 1163 1285	2518 8349	25 1891	58
59	2013 9712 4320	25 5480 8148	2562 2619	25 6234	59
60	2041 1998 2656	25 9798 0720	2605 6887	26 0577	60
61	2068 2587 6032	26 4114 9000	2649 1155	26 4920	61
62	2095 1501 4543	26 8431 2990	2692 5423	26 9262	62
63	2121 8760 4404	27 2747 2690	2735 9691	27 3605	63
64	2148 4384 8048	27 7062 8101	2779 3957	27 7948	64
65	2174 8394 4214	28 1377 9225	2822 8224	28 2291	65
66	2201 0808 8040	28 5692 6061	2866 2490	28 6634	66
67	2227 1647 1148	29 0006 8611	2909 6756	29 0977	67
68	2253 0928 1726	29 4320 6876	2953 1021	29 5320	68
69	2278 8670 4614	29 8634 0857	2996 5285	29 9663	69
70	2304 4892 1378	30 2947 0554	3039 9550	30 4006	70
71	2329 9611 0392	30 7259 5968	3083 3814	30 8349	71
72	2355 2844 6908	31 1571 7100	3126 8077	31 2692	72
73	2380 4610 3129	31 5883 3951	3170 2340	31 7035	73
74	2405 4924 8283	32 0194 6522	3213 6603	32 1378	74
75	2430 3804 8686	32 4505 4813	3257 0865	32 5721	75
76	2455 1266 7814	32 8815 8826	3300 5126	33 0064	76
77	2479 7326 6362	33 3125 8561	3343 9388	33 4407	77
78	2504 2000 2309	33 7435 4020	3387 3649	33 8750	78
79	2528 5303 0980	34 1744 5202	3430 7909	34 3093	79
80	2552 7250 5103	34 6053 2110	3474 2169	34 7435	80
81	2576 7857 4869	35 0361 4743	3517 6428	35 1778	81
82	2600 7138 7985	35 4669 3102	3561 0688	35 6121	82
83	2624 5108 9730	35 8976 7189	3604 4946	36 0464	83
84	2648 1782 3010	36 3283 7004	3647 9204	36 4807	84
85	2671 7172 8403	36 7590 2549	3691 3462	36 9150	85
86	2695 1294 4218	37 1896 3823	3734 7720	37 3493	86
87	2718 4160 6536	37 6202 0828	3778 1976	37 7836	87
88	2741 5784 9264	38 0507 3565	3821 6233	38 2179	88
89	2764 6180 4173	38 4812 2034	3865 0489	38 6522	89
90	2787 5360 0953	38 9116 6237	3908 4745	39 0865	90
91	2810 3336 7248	39 3420 6174	3951 9000	39 5208	91
92	2833 0122 8704	39 7724 1846	3995 3255	39 9551	92
93	2855 5730 9008	40 2027 3253	4038 7509	40 3894	93
94	2878 0172 9930	40 6330 0398	4082 1763	40 8237	94
95	2900 3461 1363	41 0632 3280	4125 6016	41 2580	95
96	2922 5607 1356	41 4934 1900	4169 0269	41 6923	96
97	2944 6622 6162	41 9235 6260	4212 4522	42 1265	97
98	2966 6519 0262	42 3536 6359	4255 8774	42 5608	98
99	2988 5307 6410	42 7837 2200	4299 3026	42 9951	99

AUXILIARY TABLE.

1	0000	0000	0000
2	3010	2999	5664
3	4771	2125	4720
4	6020	5999	1328
5	6989	7000	4336
6	7781	5125	0384
7	8450	9804	0014
8	9030	8998	6992
9	9542	4250	9439

2. It is obviously unnecessary to form any more separate multiplicands after the fourth, as the effective figures from that point undergo no change. Two additions are thus saved.

3. A farther abbreviation is to commence the operation with the product of the first two factors, (7 × 124=868,) which may be formed mentally. The next product then will fall *three* places to the right of this multiplicand. This abbreviation will be employed in succeeding examples.

Example 2.

Given log π = 0·49714,98726,94; required π.

497149872694		
477121254720	3	
20028617974		
17033339299	04,	Col. I.
29952 8675		
2986340857	69	„ II.
8937818		
8685803	20	„ III.
252015		
251891	58	„ IV.
124		
87	02	„ V.
37		
37	85	„ VI.

3 1 2	3 × 104
1 8 7 2	6
2 8 0 8	9
3 1 4 1 5 2,8	
6 283056	20
,3,1,4 1,5,9 083056	
157080	5
25133	80
63	2
25	8
2	5
3·1 4 1 5 9 265359	= π

Example 3.

Required the anti-log of 0·13712, 88574,21.

137128857421		
136720567156	37	Col. I.
408290265		
390689250	09	„ II.
17601015		
17371432	40	„ III.
229583		
225833	52	„ IV.
3750		
3735	86	„ V.
15		
15	35	„ VI.

137	
1233	09
1371233	
5484932	40
137128784932	
68564	5
2742	2
1097	8
82	6
4	3
1	5
1·37128857422	= Number req.

The number here found is ten times the given logarithm. It is therefore a root of the transcendental equation,

$$10^{x:10} = x.$$

Example 4.

Given the logarithm 2·94250,41061, 68; required the corresponding number.

942504106168	
903089986992	8
39414119176	
37426497941	09
1987621235	
1949941084	45
37680151	
37347720	86
332431	
330064	76
2367	
2345	54
22	
22	51

8 7 2	8 × 109
3 4 8 8	4
4 3 6 0	5
8 7 5 9 2 4,0	
7 0 073920	8
5 255544	6
,8,7,5,9,9,9 329464	
613200	7
52560	6
4380	5
350	4
44	5
1	1
8 7 5·9 9 9 999999	

The logarithm here given is that of ·876. There is a deviation from the truth of a unit in the ninth decimal place.

Example 5.

Required the anti-log. of 2·73320, 59509, to ten places.

7332059509	
6989700043	5
342359466	
334237555	08
8121911	
7810274	18
311637	
308338	71
3299	
3257	75
42	
42,97	
5 4 0	5 × 108
5 4 0	1
4 3 20	8
,5,4,0,9,7,20	
3 78680	7
5410	1
3787	7
270	5
49	9
4	7
5 4 1·0 1 08200	=Number req.

This example was given in one of my previous papers, and the latter part of the operation there may be compared with the part corresponding here. The previous operation has 100 figures set down, and besides the multiplications common to both processes, it contains five substractions and a multiplication by 6. The present operation requires only 47 figures, and it consists of two additions. These examples may suffice for illustration of the method.

The table was formed as follows:—Column I. is taken from Hutton's Table of Logarithms to 20 places. The other columns were formed by interpolation, every tenth value being independently constructed. These fundamental values for column II. were obtained by a little management from the table just referred to, and for the other columns they were found by Mr. Weddle's method. In interpolating the remaining values fourth differences were employed for column II, second differences for column III, and first differences for column IV. The values are all true to the nearest unit in the twelfth place.

37, Baker-street, Lloyd-square,
December 21, 1847.

HOROLOGICAL TELL-TALES.

Sir,—I perceive in the columns of your Magazine, Dec. 4, an apparatus registered by a Dublin watchmaker under the Act for the Protection of Articles of Utility. I am at a loss to discover in what its novelty, and consequently utility, consists, for it seems to me to correspond exactly with the sort of tell-tale which has been in use as long as I remember, and is thus described in Thomson's "Time and Timekeepers," (p. 165,) published in 1842.

"The tell-tale Clock was invented to insure the presence and attention of sentinels and night watchmen; forty-eight moveable pins project round the edge of the dial, which turning round once in twelve hours, brings one of these pins under a fixed hand each quarter of an hour; this fixed hand indicates the time, while behind the hand is a *lever* push-piece, which when pulled by a cord pushes in the projecting pin; therefore if the person whose duty it is to watch is not on the spot to pull the cord when the pin is at the index, it would remain projecting, showing his neglect at the exact quarter at which he was absent."

Every reader must perceive the exact similarity between the old tell-tale and the new one registered, by which there is but one fact clearly demonstrated; namely, that money is more plentiful in Ireland than it is here.

I am, Sir, yours, &c.,
AN OLD CLOCKMAKER.

Birmingham, February 3, 1848.

SANDEMAN'S COLD AND THERMAL PROCESSES OF BLEACHING.

[Patent dated July 31, 1847. Patentee, Hector Sandeman, of Tullochfield, near Perth. Specification enrolled January 31, 1848.

The cold and thermal processes which we have now to bring under the notice of our readers, seem destined to produce a change in the art of bleaching, which can be likened to nothing so well, as the great revolution produced in the iron manufacture by the introduction of the hot blast. They are founded on a peculiar property of hydrates of lime—a property possessed, we believe, by no other aqueous solutions whatever—namely, that the colder the water, the greater is the quantity of the solid matter (lime) which they absorb. Nearly all the expense to which bleachers are now put for furnaces and fuel will be henceforth saved, and their business done, at the same time, in a much more effectual, expeditious, and satisfactory manner. We extract the following details from the Patentee's specification:

First Process.

According to the modes or systems now followed of clearing, scouring, and bleaching textile fabrics composed of cotton, flax, tow, China grass, phormium tenax, or New Zealand flax, straw, hemp, silk, wool, and other fibrous materials, and of similarly treating the said materials in their crude state, or in a spun state, as yarn, thread, or twist, it is usual to employ potash, pearlash, barilla, soda, soda-ash, hard and soft soap, lime, and other alkalis or alkaline earths, in aqueous solutions, or mixtures at the boiling temperature, or at a temperature closely approximating to boiling. Now, my first improvement consists in employing the said solutions and mixtures in a cold state only, preferring to use them at the temperature of the atmosphere at the time, and never in any case at a temperature higher than can be obtained without the aid of fire; wherefore, and in contradistinction to the hot or boiling processes commonly followed, I designate mine "The Cold Process of Clearing, Scouring, and Bleaching." The details of this process are as follows:—When the goods to be subjected to the process consist of any of the materials aforesaid in a woven state, I first give them a preparatory steeping in warm water, in order to soften and expand their fibres, and make them thereby more open to the subsequent action of the alkaline solutions; but when the materials are in a crude or spun state, this preparatory steeping may be dispensed with. The goods being either so prepared, or in the original state in which they are sent to the bleachers, I immerse them in the said cold alkaline solutions, in such manner as that every fibre shall be thoroughly soaked or impregnated with them; and the better to ensure such result, I leave the goods so immersed for several hours,—say twelve, more or less, as may seem necessary. Any of the alkalis and alkaline substances before enumerated may be used, but I prefer lime, and in the state commonly called milk of lime, because, while sufficiently effectual, it is cheap, and because also a much larger quantity of it can be dissolved by cold than by boiling water. In preparing this hydrate of lime, I first sift slaked lime to a very fine powder, and then steep it in water for several hours. In afterwards mixing it with cold water, to form the alkaline mixture in which the goods are to be immersed as aforesaid, I find it of advantage that more lime should be used than can be dissolved by the quantity of water employed, because the oils, or oily matters, usually contained in the goods, form chemical combinations with portions of the lime in the solution, which would by such abstraction be soon deprived of its activity as a detergent, unless there were an excess of lime sufficient to keep up the solution to its full point of causticity. Solutions of chloride of lime, or potash, for dilute sulphuric acid, are employed in aid of this cold process, in the same way as they have been heretofore used in other processes of bleaching. In a great many if not a majority of cases the goods may be brought to a sufficient degree of clearness and whiteness by the cold process alone. When, however, a still greater degree of whiteness is required than the cold process is capable of accomplishing, my usual practice is to take the goods after they have gone through the said process, and steep or buck them in a weak solution of any of the fixed alkalis or soap, either in a state of ebullition or of approximation to it. The quantity of lime expended in this cold process is much the same as when lime is used according to the ordinary hot or boiling processes. When lime alone is used throughout the process, all the difference between the cost of this cheap article and the cost of any of the fixed alkalis, or of soap, is saved. And so also when none but cold solutions are employed, there will be a saving of all the cost and trouble of furnaces and fuel. But in every case, whether any of the fixed alkalis are used in aid of the milk of lime, or not, whether solutions of a higher temperature are partially had recourse to or not, the saving in materials and labour effected by this cold process is very great compared with the cost of the ordinary hot or boiling processes. Moreover, yarns,

thread, or twist, which have gone through this cold process, are found to retain more of their original strength, firmness, levelness, and weight, and to be much freer from ooziness of fibre than those which have been treated according to the ordinary hot or boiling processes. In like manner all cloth bleached by this cold process retains more of its original strength, firmness, elasticity, and weight, than that which is bleached by the hot or boiling processes heretofore pursued.

Second Process.

My invention consists, secondly, in clearing, scouring, and bleaching the fabrics and materials before enumerated by a process to distinguish which equally from the "cold process" before described, and from the hot or boiling processes ordinarily followed, I call the "Thermal Process." In this second process, I use the alkaline solutions and mixtures aforesaid, at temperatures which though higher than those observed in the cold process, are yet much lower than those at which they are employed in the ordinary hot or boiling processes, and proportionately more beneficial than the latter. If the milk of lime be made use of, (which I prefer in this case as well as in the cold process,) I employ it with more or less advantage at temperatures varying from the mean temperature of the atmosphere up to 170° Fahrenheit. If any of the other alkaline solutions and mixtures aforesaid are made use of, the temperatures at which they are employed cannot with any degree of utility be carried beyond 150° Fahrenheit.

Third Process.

My invention consists, thirdly, in the employment in clearing, scouring, and bleaching the fabrics and materials before enumerated of what I call a "binary compound," prepared in manner following:—To milk of lime I add a clear solution of chloride of lime, and stir the two substances well together: the quantity of lime used may be much about the same as that now used by bleachers in their hot or boiling processes, and the strength of the chloride solution may be such as is commonly employed in bleaching operations, using it stronger or weaker according to the degree of dispatch with which the bleaching process is required to be performed. I prefer using this binary compound in the cold state, which may be used with more or less advantage at any degree of temperature not injurious to the goods. I immerse the goods in this binary compound for a period of from twelve to twenty-four hours, more or less, according to the strength of the compound and convenience. In general I find that the bleaching process goes on as well by one steeping of the goods in this compound as if they had been first steeped in the milk of lime, and then in chloride of lime solution, (as is usual in bleaching by the hot or boiling processes,) so that not only one operation out of the two is dispensed with, but the entire process of bleaching effected in less time; besides which there is a great saving in washing and in other subordinate manipulations. Although I have mentioned, and prefer the hydrate and chloride of lime as the materials to be used in my "binary" compound, yet any alkali, or alkaline earth in solution or state of mechanical suspension, as the case may be, will on being mixed with the solution of the chloride of an alkali, or alkaline earth, form a similar bleaching compound. My reason for preferring the hydrate and chloride of lime is simply because of their cheapness, while as far as my experience goes they are as effective as any materials that can be used.

CONFIRMATION OF PATENTS.

Judicial Committee of the Privy Council, *February 9th.*

[*Present.—Lord Langdale, Lord Campbell, Dr. Lushington, Mr. Pemberton Leigh.*]

Petition of Nathaniel Card.

Mr. W. D. Hill (with whom were Mr. Russel Gurney and Mr. Webster) stated that this was an application for the confirmation of letters patent, founded on the provision of the statute 5 and 6 Will. IV., c. 83, by which it is provided, *inter alia*, that when a patentee "shall discover that some other person has, unknown to him, invented or used" the same invention as that for which he has obtained his letters patent, "or some part thereof, *before the date* of such letters patent, it shall and may be lawful" for him to petition the Crown for a confirmation of his patent, notwithstanding such prior use; and that the matter of such petition shall be heard before the Judicial Committee of the Privy Council, who, on "being satisfied that the patentee believed himself to be the first and original inventor, and being satisfied that such invention or part thereof had not been publicly and generally used before the date of such letters patent, may report their opinion that the prayer of such petition ought to be complied with," &c. The petitioner, Nathaniel Card, had invented certain improvements in the manufacture of wicks for candles, and in the apparatus connected therewith, for which he obtained letters patent dated 8th Sept., 1841. These improvements were three in number; but the principal one, and that on which the present question of confirmation would mainly turn, was thus described in the specification:—"The best wicking is manufactured from the short staple, or finest Smyrna cotton. The cotton or flax having been first spun into thread of the usual size employed for such purposes, two or three such threads are to be doubled or slightly twisted together (I prefer two) into a strand or twist, and afterwards as many in number of such strands or twists as are intended to constitute the wick are to be placed together, and again twisted from end to end to form the complete wick

It will be understood that the principal feature of novelty in this improved manner of forming the wick, *is simply the use or application of doubled threads or strands being twisted together to form the wick, instead of taking single threads and twisting them bodily together, as hitherto done in making wicking.*" The superiority of these double-thread wicks consisted in their being free of "wasters"—preserving their perpendicularity better—giving a brighter flame, and burning much longer. They had been much approved, and were now being extensively used. But very recently the petitioner had discovered that such wicks had been used by a person of the name of Howe, a candle-maker, at Brinklow, in Warwickshire, prior to the date of his (Card's) patent. And therefore the present application for a confirmation of the patent under the before-quoted provision of the statute.

A great number of persons connected with the candle-manufacture, and belonging to all parts of the kingdom—London, Manchester, Derby, Leeds, Hull, &c. &c.,—were then called as witnesses, who concurred in stating that wicks of double-thread twist were wholly unknown to the trade prior to Card's patent, and that they were now generally preferred to all others for the reasons before given.

Mr. John Howe, of Brinklow, the party referred to in the opening speech of counsel, was then examined. He had been in partnership with a brother, as candle-manufacturers, at Brinklow, and during the subsistence of the partnership his brother introduced into the house the use of double-thread yarn for the wicks. This was from twelve to fifteen years ago. It was what was called "hosiery yarn," and purchased from the Leicester agent of Messrs. Strutt and Co., of Derby. It was found to answer better than any other sort of yarn they had ever used, gave great satisfaction to their customers, and they continued from that time forth to employ it. The partnership between him and his brother had been dissolved, when the witness remained in business at Brinklow, and his brother established a manufactory in a different part of the county (Warwickshire). His brother had since died, and his business was now advertised for sale by his assignees. He had himself continued to use the double-thread wicks down to the present time, and his brother had also continued to use them to the period of his death. He had never made any secret of his use of this description of yarn; had been spoken to about it by various parties; and on such occasions had freely told them all he knew of its advantages, and where it was to be procured. He believed there was one other house which had adopted it. He had not at first paid any attention to the mode in which the yarn was manufactured; preferred it simply because it was the best for the purpose of candle-wicks to be found in the market; and would not deny that when lately applied to by Mr. Card on the subject, he might have said that he was not aware that the yarn he used was of the double sort. [Shown a specimen of the petitioner's yarn.] He could see no material difference between the petitioner's yarn and his own; the former was a little better twisted, that was all.

Mr. Hill here proceeded to press the witness as to h s belief in the perfect similarity of the two articles, when

Lord Langdale asked whether the counsel meant to say, that supposing Card's patent to stand good, the sort of wick used by Howe would not be regarded as an infringement of it?

Mr. Hill admitted that it would.

Lord Campbell. Why that is the very case the petitioner has to make out to entitle him to the confirmation he now applies for.

Lord Langdale (to witness).—Have you come to any arrangement with the petitioner as to your future use of these double wicks in the event of his patent being confirmed?

Mr. Howe.—No; I have not; and I consider it will be very much to my prejudice if the present patent is confirmed.

Mr. Russel Gurney said, they had no wish to bear hard on Mr. Howe, and would be content to take the confirmation subject to the condition of granting him a free license during the remainder of the patent.

Lord Campbell.—But there is the brother—his business is for sale; to be sold of course as it was at the time of his death.

Mr. Gurney.—We are willing to give the brother's executors also a license.

Mr. Waddington, for the Crown, then addressed their lordships. He submitted that no sufficient case had been made out for the confirmation of the subject.

The Court having been cleared, on its being again opened,

Lord Campbell:—Their Lordships are of opinion that the prayer of this petition ought not to be granted. It is a very extraordinary power this which is vested by the Legislature in the Judicial Committee, and ought to be very cautiously exercised. By the law as it before stood, it was necessary for the validity of a patent that the invention should be new as well as that it should be useful, and if it could be proved that the invention had been practised publicly by any person before the patent was granted, the patent was invalid. That law led to hardship in many cases; because it often happened that experiments had been made,—that a certain progress had been made in an invention,—that those experiments proved abortive and were abandoned,—that some other ingenious man began *de novo*, investigated the subject, and completed the process, by which a great benefit was conferred on the community; this person then gained a patent for his invention from the Crown, and by his specification might have communicated it, and having conferred a great benefit upon the public, when he began to make his profit, his patent was infringed, and when he brought an action against those who infringed the patent, the preceding abortive experiments were brought up as proof that the invention was not new. Some doubt existed in Westminster Hall, whether if an experiment, although it had been to a certain degree successful, had been abandoned, it would vitiate the patent; but to remove all doubt upon the subject, this enactment was resorted to by the Legislature, and I think most beneficially if it be properly applied—that although there may have been a general knowledge of an invention,—the meaning was, if it was not actually carried into effect,—if it had been abandoned, that that knowledge should not vitiate the patent by which the discovery was perfected and rendered beneficial. Now the language of the Legislature is this, that the Committee, upon examining the matter, and being "satisfied that such patentee believed himself to be the first and original inventor, and being satisfied that such invention, or part thereof, had not been publicly and generally used before the date of such letters patent, may report to the Crown their opinion that the prayer of such petition ought to be complied with, whereupon the Crown may grant a confirmation of such letters patent, so as to give to such petitioner the sole right of using, making, and vending such invention as against all persons whatsoever—probably with the words meant to be understood, notwithstanding any prior use of the said invention. Then the Judicial Committee must first see that the petitioner believes himself to be the first and original inventor. Upon that part of the case, it seems to their lordships that the petitioner has not afforded them sufficient evidence from which they can reasonably infer that he was the first inventor. He has not shown any experiments which he made, and peradventure he merely may have bought a little of some hosiery yarn, and stumbled upon the improvement as Mr. Howe said he did. But, however, supposing he were really the first inventor, and believed himself to be so, it seems to their lordships that this is not a case in which it would be proper for the patent to be confirmed. For here we have had it in evi-

dence that another candle-maker had adapted the same manner of making wicks before the patent was taken out,—that he practised it in one part of Warwickshire and his brother in another part of the country—that they considered it a great improvement both with regard to the economy of cotton and the brightness of the flame; and that instead of abandoning it as abortive, they continued to practise it, and to practice it with advantage—the deceased, Mr. Howe, until his death, and we have every reason to believe that since his death, the trade has been carried on exactly in the same manner by his assignees; and the Mr. Howe who has been examined here as a witness, has continued to practice that mode of making candle-wicks down to the present day. He has mentioned it to others—he tells us that he believes another candlemaker had adopted it; and for anything that we know, it may have been adopted by various other members of that trade. Under these circumstances, see what gross injustice would be done if the patent were, confirmed. Immediately the trade of Mr. Howe, who has been examined here as a witness to-day must be stopped; he would be liable to an action if he were to continue his trade in the manner in which he has carried it on for many years. It would be no defence to him when that action came on to be tried, to prove that he had done no more since the confirmation of the patent than he had done before—that he was supporting himself and his family as he had done previously; the confirmation of the patent would be absolute and conclusive evidence that the invention was new, he would be liable to damages and to all the costs of the action. It has been said that this may be guarded against by the petitioner undertaking to give Mr. Howe a license. I do not know that it would be fair to subject him to the risk that he would undergo by a license of this sort, or with regard to the terms of that license. But what is to become of the trade of the brother, which is now carried on for the benefit of the creditors? It has been said that a license might be granted to those who are carrying on that trade. But we know not: the probability is, that there are others who are carrying on the same trade who might be brought, without any intention, into an action at law which might bring ruin upon them.

Their lordships are of opinion, therefore, that this is not a case which the Legislature had in contemplation when this enactment was passed; that it had in view the case where there had been an invention which had actually been practised, but which had not been continued to be practised; so that under those circumstances the patent should not be rendered invalid by those abortive attempts: and where the patent under those circumstances is confirmed, no injury is done to any one;—the inventor who has gained his patent and made it public for the benefit of the community, has his fair reward for his ingenuity and his industry and the capital which he has employed, and no one suffers by justice being done to him: therefore in a case where it appears that an invention has been carried on to a certain degree, and abandoned, the Act of Parliament may most beneficially be acted upon. But their lordships are of opinion that a case of this sort, where the invention was carried on before the patent was granted, was considered beneficial by those who carried it on, was proved to be beneficial by them, has never been abandoned, and is carried on by them down to the time at which the application is made, is a case to which the Act of Parliament never was intended to apply, and that therefore the application ought to be refused.

BAKER'S "RAILWAY ENGINEERING."

Sir,—I regret to observe that, in your Magazine of the 5th instant, you have inserted a review of my "*Railway Engineering and Earthwork Tables,*" containing some very unfair remarks on that work. The chief object of the review in question is, apparently, to charge me with having pirated *Mr. Bashforth's* work. As it is probable I may elsewhere have an opportunity of proving the groundless nature of that charge, I shall now content myself with denying it in the most emphatic manner. I trust to your sense of justice to insert this communication in the forthcoming number of your Magazine.

I am, Sir, yours, &c.,

THOMAS BAKER.

25, Vauxhall-street,
Feb. 9, 1848.

[As Mr. Baker states that it is probable he may have "elsewhere" an opportunity of proving the groundless nature of "our charge of piracy against him, and contents himself, therefore, for the present with denying it," we, too, under these circumstances, can only say that we adhere to our charge in all its latitude, and are prepared, whenever the occasion offers, to sustain it. ED. M. M.]

INQUIRIES AND ANSWERS TO INQUIRIES.

Franklin's Electric Feast.—"*Negative Pole*" is perhaps right, and his friends wrong. On referring to Franklin's letter to Collinson, we find that he does not say the feast was actually held—only that it was intended to be held. "The hot weather coming on, when electrical experiments are not so agreeable, *it is proposed* to put an end to them for this season—somewhat humorously, in a party of pleasure, on the banks of the Schuylkill. Spirits, at the same time, *are to be* fired by a spark sent from side to side through the river, without any other conductor than the water: an experiment which we some time since performed to the amazement of many. A turkey is to be killed for our dinner by the *electric shock*, and roasted by the *electric jack*, before a fire kindled by the *electrified bottle;* when the healths of all the famous electricians of England, Holland, France, and Germany, *are to be* drunk in *electrified bumpers*, under a discharge of guns from the *electrical battery*."

Standard Gold of England and France.—"O. S. G." The standard gold of England consists of 11 parts gold and 1 copper; that of France, 9 parts gold and 1 copper.

Sulphuric Acid.—"M. Farrance." The getting back of the sulphuric acid used in the manufacture of soap has ceased to be an object, since the exportation of sulphur from Sicily has been thrown open (1838,39) and the price consequently reduced from 300 to 400 per cent. It costs now (we believe) in large quantities not more than 3*s.* 4*d.* per lb. Besides, if it were an object to recover it, there are already many processes patented for the purpose, and some of them quite good enough.

NOTES AND NOTICES.

Well Boring.—A recent attempt at boring for water in Venice has proved a total failure, and has been completely abandoned, with a nett loss to a French Company of three or four hundred thousand francs. A project of M. Grimaud de Cauk to furnish the city with pure river water by an aqueduct has again risen into favour, and will probably be adopted by the local authorities.

Swedish Steam Navy.—The King of Sweden has ordered that no further sailing-vessels shall be built for the Swedish Navy: but that the steam force be considerably augmented and constitute in future the main strength of the naval force of his kingdom. The new steam fleet is to consist of four steamers of 400-horses power each; eight of 500 h. p.; eight of 300 h. p.; four of 200 h. p.; eight of 100 h. p., and one mortar steamer.

Death of Men of Science.—Sir Charles Blagden died in his chair while taking coffee with Gay Lussac and Berthollet, and that so silently, that there was

not a drop spilled from the cup in his hand. Dr. Black also died so composedly, that the milk he was drinking from a spoon was all preserved. Dr. Wollaston watched with scientific interest the gradual failure of his own vital power. Dr. Cullen whispered in his last moments, I wish I had the power of writing or speaking, for then I would describe to you how pleasant a thing it is to die!—*Dr. Denby.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Robert Fowles, of North Shields, Northumberland, gentleman, for certain improvements in propelling. February 8; six months

James Bird, of the Cwmn Avon Works, Taiback, Glamorgan, gentleman, for certain improvements in liquid measures. February 8; six months.

Godfrey Anthony Ermen, of Manchester, cotton-spinner, for certain improvements in machinery or apparatus for twisting cotton or other fibrous substances. February 8; six months.

Richard Clarke Burleigh, of Featherstone-buildings, Middlesex, gentleman, for improvements in burners for obtaining or producing light and heat, and in apparatus to be used therewith. February 8; six months.

Jacob Brett, of Hanover-square, Middlesex, for improvements in electric printing and other telegraphs. February 8; six months.

William Heywood Glover, of Stone Bridge, Chester, for improvements in the manufacture of oil from blubber. February 8; six months.

William Sangster, of Regent-street, Middlesex, for improvements in umbrellas and parasols. February 8; six months.

Jean Napoleon Zerman, of Greenwich, Kent, captain in the French navy, for improvements in ships and other vessels. February 8; six months.

Luke Hebert, of Ryde, Isle of Wight, civil engineer, for improved machinery for reducing, grinding, and sifting bark, sugar, coffee, seeds, and other substances. February 8; six months.

William Peter Piggott, of Oxford-street and Wardrobe-place, Doctors' Commons, for certain improvements in nautical instruments, and in the manufacture of cases for containing instruments, goods, or merchandise. February 8; six months.

Jean Marie Magnin, of Villefranche, (Rhone), France, avocat, for improvements in machinery for sewing, embroidering, and for making cords or plats. (Being a communication.) February 9; six months.

Gustav Adolph Buckhobz, of Forston-street, Middlesex, gentleman, for improvements in obtaining motive power. February 9; six months.

Felix Douche, merchant, of Rouen, France, for certain means, processes, and apparatus for preventing in many cases the escape of heat through boilers and apparatuses, and for saving and applying the lost heat in general, and sometimes direct heat, to many useful purposes. February 10; six months.

William Jeary Cannon, of Cambridge, solicitor, for improvements in the construction of carriages for the conveyance of sheep and other animals on railways. February 10; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Feb. 3	1342	John Young	Ayr, engineer	Machine for making pipe-tiles.
4	1343	John Randolph Remington	Alabama, United States, but now of Stafford	Improved mill-stone.
7	1344	John Thompson Wilson	Hammersmith, builder	Improved chimney-top to prevent chimneys from smoking.
8	1345	Richard Robinson	Eliza-street Works, Belfast, agricultural engineer and machine-maker	Steam-boiler water gauge.
9	1346	Joseph Sherwin	Norton Folgate, London, iron-founder and patent range manufacturer	Double draft register stove.
,,	1347	Abraham Abrahams	Liverpool, optician	Dissolving view lantern.
10	1348	John Randolph Remington	Alabama, United States, but now of Stafford	Condensing and digesting coffee and teapot top.
,,	1349	William Weston	Wood-street, Cheapside, shirt-manufacturer	Aptandum shirt.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166 Fleet-street.

GODFRAY'S AGROMETERS.

Fig. 1.

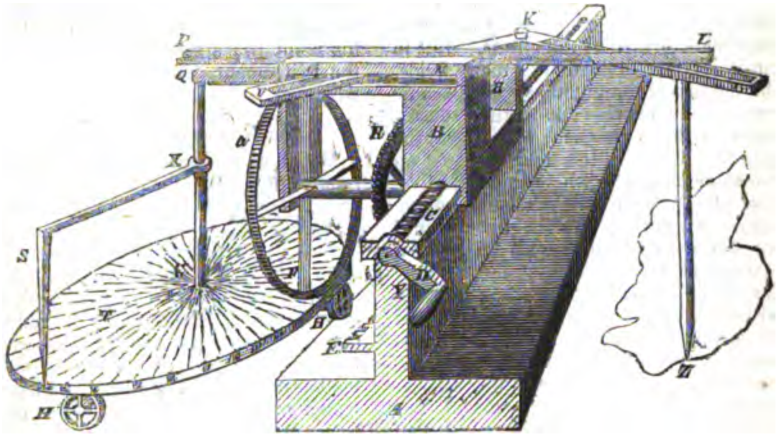
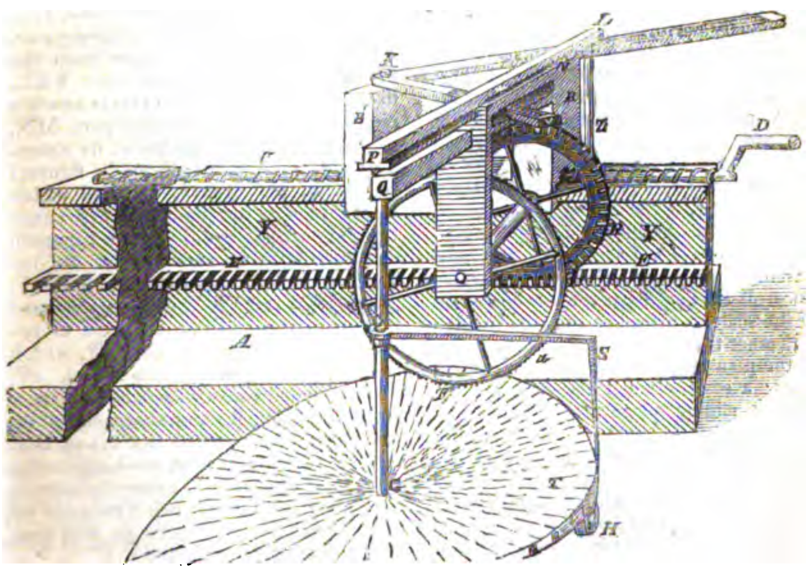


Fig. 2.



DESCRIPTION OF A RECTANGULAR AGROMETER AND CIRCULAR AGROMETER, TWO INSTRUMENTS FOR MEASURING THE AREAS OF LANDS. HUGH GODFRAY, ESQ., JERSEY.

In determining the area of an estate, the most correct method is to measure on the ground all the lines necessary for the computation, dividing the estate into triangles, and making use of the formula which gives the area in value of the three sides, and computing séparately the small trapezoids formed by the offsets. But in large estates, divided into many fields, this method of computation would become exceedingly operose; it is then customary to make an exact plan from the measures taken in the field and cast up the contents of the whole and of individual pieces, from measures taken on the plan, by drawing straight lines round the figure to be measured, in such a manner as to substitute straight boundaries for the curved or crooked ones, without altering the area. This is effected by means of a straight edge of horn-paper, or with a fine thread, or horse-hair stretched by a bow, and placed so as to take in as much space as it cuts off. The figure is thus reduced to a polygon of a small number of sides, and this is again divided into triangles and quadrilaterals, and the diagonals, perpendiculars, &c., measured on the scale from which the plan was drawn. The work is thus expeditiously performed; but if the boundaries are very irregular, this method will, even with a practised eye and hand, be in some degree uncertain.

A much better method, because it dispenses with the drawing of lines on the plan, and also because the lengths of boundaries to be equalised will be generally shorter, is the following, which is, I believe, in use in the Tithe Commission Survey:—A large piece of transparent horn-paper ruled with parallel lines all at equal distances, say one chain of the scale, is placed on the plan in such a manner that the top and bottom limits of the plan may be on two of the parallel lines; a scale divided also into chains, with a sliding piece attached, is then made use of to measure the length of each portion of the plan comprised between two parallels, the eye deciding where to begin and where to end, so as to equalise the end boundaries of each breadth; but this also in some cases may be a matter of some difficulty when the plan has many sinuosities.

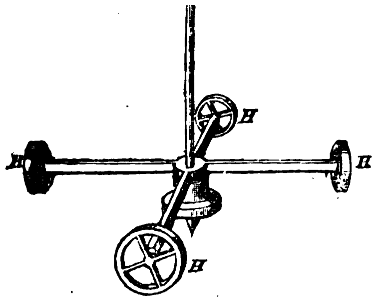
I have imagined two instruments for measuring the area of a field from the correctly drawn plan, and by these instruments, which I have called *Agrometers*, the accurate area will be obtained by merely passing a tracer over the boundary of the piece, following all its windings, and on returning to the starting point the area will be indicated by the instrument, without any calculation whatever.

The Rectangular Agrometer.

Fig. 1 of the accompanying sketches represents an end view, and fig. 2, a side view of the rectangular agrometer: A, is a solid piece of wood or metal, 2 or 3 feet long, with an upright Y, running the whole length of A, and carrying a small projecting rack, E; BB′, is another piece of metal carrying the remainder of the machine, and so fixed on the top of the upright Y, as to admit of motion only in the direction of its length, which motion is produced either backwards or forwards by means of the screw, C, and handle, D; VK, and KL, are two grooved arms of metal, at right angles to one another, and moveable about the pivot, K; LZ, is the tracer, which passing through the groove, KL, and being attached to the sliding-piece, LP, will, by its motion to or from the instrument, cause the bent lever, VKL, to turn on its pivot, K. QM, is another piece, moveable in the upper part, MN, of the piece, B, and having at its extremity, M, a pin (not seen in the figure,) caught in the groove, VK, and which by the motion just described will cause QM, and with it the disc, T, to approach or recede from the remainder of the instrument. R, is a toothed wheel, which, meeting the rack, E, will by the onward motion of the machine be made to revolve, and with it the wheel, *a*F, which is on the same axis. This wheel, *a*F, has a rounded rim with notches cut in a cross direction, leaving sharp edges on the outside (as seen in fig. 2,) so that when it revolves, it may, catching on the surface of the disc, T, cause the disc to turn also; but the rim being rounded off and the notches cut crossways, will present no obstacle to the motion of the disc to or from this wheel.

The support, GQ, (fig. 4) passes through the centre of the disc, and has

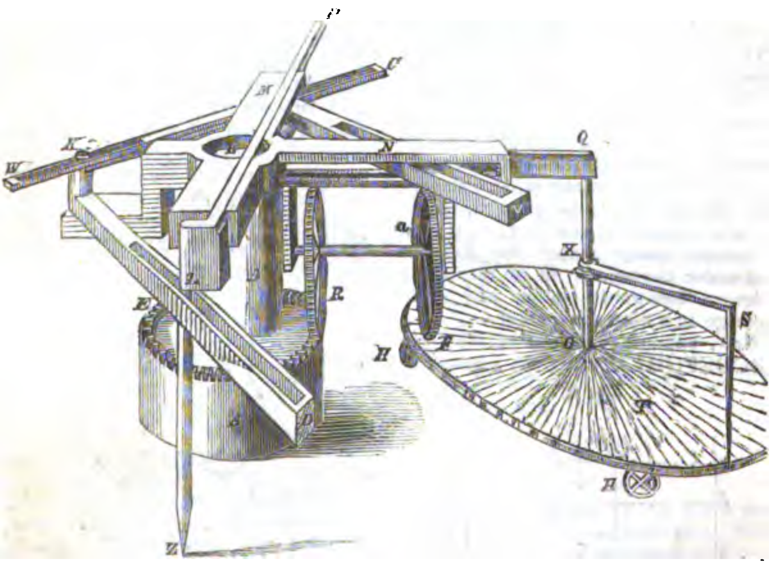
Fig. 4.



a cross piece with four small wheels, HH, fixed at the extremities. The disc is not attached to GQ, but is merely placed on the wheels, HH, by which means the friction is greatly diminished, and a very slight effort of the notched wheel will cause the disc to revolve. I think a disc with a surface of caoutchouc, or of gutta percha, would be found to answer the purpose, as the notches would sink in sufficiently to hinder slipping, without causing obstruction by the cross motion; besides, by means of a nut and screw (fig. 4) the wheels, HH, could be raised or lowered, so as to increase or diminish the pressure, but it must be remarked, that the wheels, H, are never to come in contact with the plan.

The bottom of the disc—at least those parts which bear on the wheels, H—must be of some hard and smooth substance, and the rim must be such as to allow of legible divisions being engraven upon it. S, is a pointer to indicate the area; it is attached to the support, GQ, and can be turned so as to be opposite any one of the divisions of the disc, but it must be clamped to the support when the instrument is in motion.

Fig. 3.



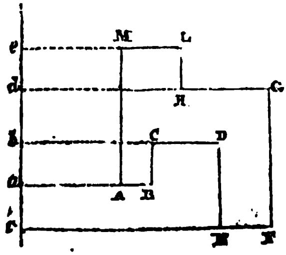
Let N be the foot of the perpendicular from K, on M L; then M, K, L, being a right-angled triangle, we have $MN.\ NL = \overline{KN}^2 =$ constant. Now, let the distance, FG, from the centre of the disc to the point of contact, F, with the wheel, aF, be, in constructing the instrument, made equal to MN, then it is evident, that they will remain equal in all positions of the disc, for G and Q move over the same space as M; we have, therefore, $GF.\ NL =$ constant. Again: let r be the radius of the notched wheel, and for an onward motion of the machine $=h$, let it describe the $\frac{m}{n}$th of a revolution, and let $x =$ distance, FG, corresponding to a distance, $NL = y$ of the tracer from N; then, if we keep the tracer at this distance, y, and

by means of the screw, C, move the whole onwards a distance h, there will be enclosed, between the extreme positions of N, and the tracer, a rectangle whose area is $h\ y$, and the $\frac{m}{n}$th portion of the circumference of the notched wheel will have come in contact with the disc, causing the latter to describe an angle $= \frac{m}{n} \cdot \frac{2\pi r}{x} = d.$

Now, suppose the distance of the tracer be changed to θy, then, since xy=constant, x will be changed into $\frac{x}{\theta}$ and if we again move a distance equal to h, the area enclosed between the tracer and N, will be $\theta h y$; but the angle described by the disc will now be $= \frac{m}{n} \frac{2\pi r}{\frac{x}{\theta}} = \theta d$; that is, the velocity of the disc's motion will vary as the area enclosed: if, therefore, divisions are made on the rim of the disc to indicate by the numbers which pass opposite the pointer, S, the area enclosed when the tracer is at any one distance from N, the same divisions will correctly indicate the area at any other distance; and when the motion is reversed, that of the disc will also be reversed; that is, if an onward motion makes the divisions pass under the pointer in an increasing order, a backward motion will make them go in a decreasing order.

Now, suppose a figure of the form ABCDEFGHLMA (fig. 5) whose an-

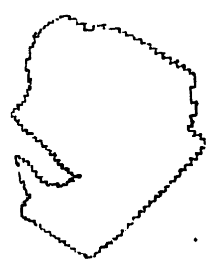
Fig. 5.



gles are all right angles, and suppose the line, NK, of the instrument to be placed over line, $c\ e$, parallel to one of the sides, AM, and at any distance from it. Placing the tracer on A, and adjusting the pointer to the zero of the disc, then drawing the tracer from A to B, the disc will not revolve, and the pointer will still mark zero; now, moving onward from B to C, the pointer will indicate the area, a C; then from C to D, the area indicated will still be aC; but in the backward motion from D to E, the disc will turn in the reverse direction till a number of divisions representing the area bE, have been passed over, and the area indicated will now be, aC$-b$E, that is, a negative quantity. In the progress of the tracer from E to F the disc will retain the same position with respect to the pointer, but in the next onward motion from F to G, a number of divisions equal to the area cG will be passed over, and the area now shown will be aC $- b$E $+ c$ G. Proceeding in this manner round the piece till we return to A, we shall find on the disc an area equal to aC $- b$E $+ c$G $+ d$L $- e$ A $=$ given figure.

Now, as the same method of demonstration would apply, however small the lengths of the sides, and however great their number, it will evidently also hold when the figure is bounded by curves or straight lines in any position; for, we can then suppose the whole perimeter to be made up of an infinite number of small steps, the sides of which are all parallel or perpendicular to the position occupied by the instrument, as will easily be understood by the inspection of fig. 6, where all the lines lie in two directions only,

Fig. 6.



and since, when the tracer is made to follow all the steps the area is correctly indicated, it is evident that such will also be the case when the traces follows the curve or straight line which is the limit towards which the steps tend by continually diminishing their magnitude and increasing their number.

I think the following dimensions for the principal parts of the instrument will be found to answer:

	Inches.
N K	6
Radius of disc	9
Distance between the two wheels....	7
Length of piece, L P, which carries the tracer	24

The length of sliding-piece MQ should be = distance from wheel aF, to the vertical plane through KN.

When the centre of the disc is near the edge of the wheel, aF, a very slight error in the position might cause a considerable one in the result; it will therefore be well not to let this distance be less than 2 inches, which will correspond to a distance of the tracer from the plane through KN of $\frac{6^2}{2} = 18$ ins., and when the disc is at its furthest elongation from the wheel, the tracer will be at a distance of $\frac{6^2}{9} = 4$ ins.

The instrument will thus have a scope of 14 ins. in breadth, with a length limited only by that of the instrument. If the plane to be measured should extend beyond the reach of the agrometer, it will readily occur to divide it by pencil lines into two or more parts, and to measure these separately.

The Circular Agrometer.

Fig. 3 represents another instrument for the same purpose, the description of which will be easily understood after that of the rectangular agrometer. Thus we have a solid centre piece, A, with a circular rack, E, into which the toothed wheel, R, works, and causes the notched wheel, aF, to revolve and turn the disc, T. On the upper part of A is a piece with four arms at right angles, admitting of circular motion around the fixed and solid centre, B. One of the arms, BN, carries the two wheels and the piece, NQ, by which the disc is supported. The opposite bent arm, BK, carries a fixed pivot, K, about which moves the right-angled lever, DKC. The tracer, LZ, attached to the sliding-piece, LP, passes through the groove of the arm, KD, and by its motion to and from the centre, turns the lever about its pivot, K. WMV, is another right-angled and grooved lever carrying at its vertex a pin, M (not seen in the figure), which pin is so placed in a groove of the piece, BM, as to admit of motion only to and from the centre, B, which motion is caused by that of the first lever, DKC, the pin, M, being made to pass through the groove, KC.

Again; while the vertex, M, of the second lever is made to approach or recede from the centre, one of its arms, MW, is restricted to pass through K, and the other, MV, causes the sliding-piece, NQ, and with it the disc, T, to approach or to recede from the centre; and if BN = FG at first, they will always be so, for N and G move over the same distance whilst B and F are fixed.

Now, let

$BL = x$, $BN = FG = y$, $BK = a$, $BM = z$,

then, by the property of right-angled triangles, we have

$$\left.\begin{array}{l} xz = a^2 \\ ay = z^2 \end{array}\right\} \text{whence } x^2y = a^3 = \text{const.}$$

Suppose now that the tracer, Lz, at a distance $BL = a$ from the centre, be made to describe an arc of a circle subtending an angle equal to ϕ, and that the corresponding motion of the notched-wheel, aF, about its axis be an angle β; then, r being the radius of this wheel and $GF = y$, the disc will describe an angle with respect to the pointer, S, equal to

$$\frac{\beta r}{y} = \lambda,$$

while the area of the sector inclosed by the tracer will be $\frac{1}{2}\phi x^2 = d$.

Now the radius of the tracer being altered to θx, let the same angle ϕ be described; then the sector inclosed will be $\frac{1}{2}\phi\,\theta^2x^2 = \theta^2 d$. But $x^2y =$ constant: therefore when x is changed into θx, y will be changed into $\frac{y}{\theta^2}$ and the angle now described by the disc with respect to the pointer, S, will be

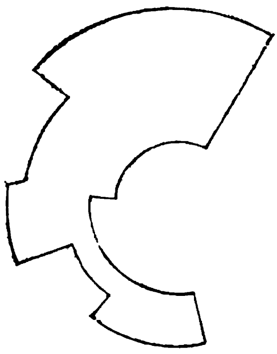
$$\frac{\beta r}{\frac{y}{\theta^2}} = \theta^2\lambda;$$

that is, the velocity of the disc's motion will vary as the sectorial areas inclosed by the tracer: if, therefore, divisions be made on the rim to express correctly the area inclosed by the tracer in one position, they will answer in all positions.

If there be a figure formed of straight lines radiating to one point, and of circular arcs, all having that point for centre, the area will be correctly given by the circular agrometer having its centre over the point; and the extension from this to any figure, and to any position of that figure, will also easily follow; as may be

seen by merely inspecting fig. 7, where the boundaries of the figure are made up of a great number of small arcs and

Fig. 7.



radiating lines; and since the agrometer will give the correct measure in this case, it evidently will also do so, when the arcs and lines merge into the continuous curve or straight line, towards which they tend.

The following dimensions would, I think, answer for a circular agrometer:

	ins.
Radius of disc	9
Distance between the two wheels ..	7
Length of sliding-piece, LP, which carries the tracer..	12
BK	6

NQ must be correctly equal to the distance from wheel aF, to the vertical through B.

Now, GF varying as before, that is from 2 to 9 ins., BL will vary from

$$\sqrt{\frac{6^2}{2}} \text{ to } \sqrt{\frac{6^3}{9}},$$

or from $10\frac{4}{10}$ to $4\frac{8}{10}$ inches nearly. Therefore a plan in the plane of which a point can be found, either within or without, whence all the lines drawn to the perimeter are comprised between $4\frac{8}{10}$ and $10\frac{4}{10}$ inches, may be measured by the circular agrometer.

Should these conditions not be fulfilled, we must draw pencil lines so as to measure in parts as before.

Note.—In both rectangular and circular agrometers, the rim of the disc is to be made wide enough to admit of several rows of divisions to agree with the different scales, from which plans are usually drawn.

Jersey, January 24, 1848.

ON THE CONSTRUCTION AND VENTILATION OF SEWERS. BY WILLIAM DREDGE, ESQ., C.E.

(Continued from page 154.)

The "Minutes of Evidence of the First Report of the Metropolitan Sanitary Commission," just published, details a vast amount of valuable practical information on this most interesting subject.

The flow of water in channels of various forms and areas, necessarily occupies considerable attention; and it is of the first importance, in laying down a system of sewerage to be cleansed by drainage and flushing water, that this branch of the subject should be thoroughly understood. It is much to be regretted, however, that we know but little about it. In no branch of mixed mathematics are we moving with greater uncertainty than in hydrodynamics. I have frequently found the formula given by writers on this science approximate nearly in practice, but as often it is altogether the contrary. Calculations from fixed data cannot be uniformly depended on in matters of this kind; for the extraneous circumstances affecting the flow of water in channels are so various in their nature, that it is impossible any general formula can embrace them all. Probably no two streams are in every respect exactly similar, and therefore it is, that a fixed mode of calculating their effects fails of the intended object.

The science of mechanics is comparatively simple; and the most intricate statical or dynamical problems, divested of the analytical reasoning with which it is fashionable to clothe them, are easily comprehended; but the mind becomes confused by the contemplation of a fluid mass consisting of an infinite number of particles, free to move from the slightest cause in every direction amongst themselves, and influenced in its onward progress by an infinite variety of external causes, all tending to falsify theoretical deduction. The atmospheric resistance,—the inclination, form, and nature of the bed and sides of the channel,—the sinuosity of its course,—the extraneous impediments which the stream encounters,—are so many quantities to be taken into consideration.

The equation

$$v = \sqrt{9582\frac{r}{m} + \cdot 0111}$$

represents the velocity of the steam in feet per second; *r*, the "radius of section" obtained by dividing the area of section by the perimeter, less the breadth, also in feet; and *m*, the denominator of the slope, the numerator being 1. Now this equation, like all others bearing on the same subject, is too general for practical application; for *r* is the only quantity in the equation expressing the infinite variety of impediments which a stream meets with in its winding course.

Mr. Cressy, the learned author of the "Encyclopædia of Civil Engineering," in his evidence before the Commission, on the theoretical flow of water in canals, is asked—

"'Have any experiments been made upon the subject, that you are acquainted with?'—'Some years since, Genneté* inquired into it, but his opinions varying with those entertained by the practical men of his day, several trials were made by the philosophers of Italy to test their truth, among whom Zendrini, who received his instructions under Guglielmini, may perhaps be considered the most industrious and successful: but it would be of the greatest possible value to have these experiments of Genneté's repeated upon a large scale, and the consequences of the increase and diminution of volume accurately noticed; the subject has never, in England, been thoroughly, or even satisfactorily investigated. Most of the experiments upon running water have been made with pipes placed one over the other, discharging their contents from a constant head. Mathematicians have contented themselves by establishing the form of curve which these several currents assume; and where the case of open canals has occupied their attention, they have experimented upon single streams alone, without observing the phenomena of united currents.'

"'If asked to proportion a sewer, do we understand you to say that you would make it to agree with the united sectional area of the drains that fall into it?'—'Certainly not; for then I should require a sewer of much larger dimensions than practice has found necessary. On this subject, as I have before observed, there is a perfect misunderstanding; most of the tables and formulæ given for pipes and their proportions are in error, in consequence of due allowance not having been made for the additional velocity which running water acquires under various circumstances. The rule hitherto employed would appear analogous to that of the managers of the river Lea when granting a pipe to the New River Company; they gave one of double the diameter upon the condition of the New River Company paying twice their former annual rent. And we are not surprised, that when sectional areas are thus computed, other errors should have occurred; for, by doubling the diameters of circles, we quadruple their areas, by which rule more than four times as much water would have passed through; for, in making this arrangement, other natural laws should have been taken into the account: these have been elaborately discussed by the Italian hydraulicians, who have proved the enormous acceleration and consequent augmentation produced by an increase of sectional area.

"'For instance, if 130,680 superficial feet of land, or three acres, could be drained during a heavy fall of rain by one foot sectional area of sewer, double that quantity of land would not require two feet sectional area of sewer. I understand Mr. John Roe's experiments, when I consider that they were under the influence of these natural laws. I refer to that part of his evidence where he states that 6 acres, 1 rood, and 8 poles of land might be drained during the time of a violent storm of rain by a sewer whose sectional area is 2·44 feet only; but because 144 square inches, or a superficial foot, may, under ordinary circumstances, be sufficient for the sectional area of a sewer, to drain 43,560 superficial feet of land, we do not say that one square inch will drain the one hundred and forty-fourth part of that quantity.'

"'Will you inform us of the nature of Genneté's experiments?'—'They were made to prove that when two streams of water running with the same velocity, and having both their sectional areas equal, were united in one stream, that their sectional area was not doubled. In Holland, it was important to decide this question; for, intersected as it is by canals and drains of every kind, and the land through which they were made being of considerable value, the inhabitants were naturally desirous of giving up as little to water-courses as possible. Genneté had evidence of the *fact* that rivers could be brought together without an increase in their *volume* proportionate to the increase in their quantity, in the confluence of the Rhine and Moselle; but what he particularly demonstrated was, that the united streams flowed on with an increase of *velocity*.

"'He seems also to have been fully aware that cutting the banks of a river for the purpose of letting off any portions of the torrent is not so effective in drawing off the water as has been generally imagined; or, in other words, that if a canal had a sectional

* Genneté's experiments were printed at Paris, 1760.—See Castelli, p. 175.

area of 100 superficial feet when swelled by floods, that 20 canals, of 5 feet area each, would not have carried off the same water, or so materially have diminished its volume as might be at first supposed.

"'Genneté's views were received by the practical men of his day much in the same manner as they would have been treated, perhaps, at the present time. There were many prejudices to be overcome, and particularly some that were generally entertained with respect to the incompressibility of water. It was argued that you could not compress a double quantity into a less space than twice the area as of each section; that two separate cubic feet of water, when put together, required a vessel whose capacity was equal to hold them both; and that two streams of the same velocity were governed by the same laws.

"'When Genneté made his experiments in 1755, in Holland, upon the sectional area of united currents of water, he discovered, after noting the height of the water in the original channel, that he could add another stream of half the original quantity, and afterwards another half, without increasing the height or width of the water in the smallest degree. The water in the stream remained during these experiments at the same height; but it was observed that the velocities of the current were in the same proportions as the additions, viz., as 1, $1\frac{1}{2}$, and 2. He, however, found a limit to this rule; for when he made the increase three times greater than it was at the commencement, instead of twice, the increase in height was $\frac{1}{48}$th part of the whole height. When he quadrupled the quantity, the increase was $\frac{1}{24}$, and when the quantities were as 5, 6, 7, the increase in height was $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{8}$, and so on in continual proportion: thus, 96 streams would require $\frac{1}{48} \times 96 = \frac{96}{48} = 2$, or the sectional area must be twice the original height.

"'To prove this, Genneté afterwards let off the water by degrees in the same proportions, and he found the same results; the diminutions were in perfect accordance with the previous experiments. Genneté, in his experiments, had a uniform declivity of 1 foot in 1,200, and his canals were six or seven inches in breadth.'"

I am not at all inclined to admit the accuracy of these experiments of Genneté with the data given above; and, to the best of my recollection, no other experimenter on this subject has drawn the same conclusions.

I am perfectly aware that the quantity of water discharged down a canal may be doubled, trebled, quadrupled, or increased any number of times, without at all enlarging the section of the stream, provided the pressure or height of the head of water or the swell occasioned by the increase of volume be increased in due ratio to produce this. But how, without any such alteration of data, the quantity of water should be doubled without augmenting the section of the stream, whilst every subsequent increase of quantity causes an increase of bulk, I cannot understand.

The quantity of water (Q) which flows down a channel in any given unit of time, is always equal to the sectional area (A) of the stream multiplied by its velocity, V, whence $Q = AV$. Now, Q being composed of two quantities, A and V, it is evident that an increase or diminution in them, either separately or conjointly, will cause a corresponding increase or decrease in the quantity of water discharged. Suppose the quantity of water discharged became n times Q, then

$$nQ = (nA)\,V \text{ or } (1)$$
$$= A(nV) \ldots (2)$$

or both A and V may vary when

$$nQ = \frac{n}{m} A m V \ldots (3)$$

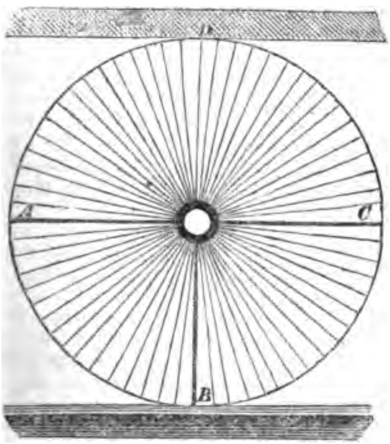
From this it is evident that if the velocity is constant, the quantity discharged will be as the area. If the area is constant, it will be as the velocity; and, lastly, a change in quantity may be consequent on an alteration of both area and velocity. It would seem, from equation (2), quite possible to produce the result Genneté did; and so it is—but not, I apprehend, with the means prescribed; for we must bear in mind that V is a function of the pressure in the direction of the flow, and varies in proportion to the square root of such pressure; the pressure is in direct ratio to the height of head, and, therefore, the velocity is as the square root of the vertical distance through which it has passed; consequently putting H = the vertical height, C, a constant coefficient. $V = C\sqrt{H}$, and $Q = AC\sqrt{H}$; or, if the quantity Q be doubled, as in Genneté's experiment, then $2Q = A\,(2C\sqrt{H})$,—data which we have no reason for assuming from the description given. I would rather suppose equation (3), under the condition, to represent the result, viz.,

$$2Q = mA\frac{2}{m}C\sqrt{H}.$$

In my next I propose to investigate the flow of water as if it were free from friction and all other extraneous impediments. Practically, this is an impossible case; but it will serve to demonstrate the effect of one set of forces, and show that a fluid gathers velocity as it passes down an incline in a greater ratio than a solid would.

(*To be continued.*)

A MODE OF OBTAINING MOTIVE POWER BY ELECTRICITY OR ELECTRO-MAGNETISM.



The carriage containing the motive power is to be constructed as a first or second-class passenger carriage, with six wheels. Four of these wheels are to be similar to those of the ordinary construction, and the two centre wheels are to be constructed by combining a series of magnets or electro-magnets radiating from the centre, and each magnet placed as close to the adjoining one as possible, consistently with the introduction of an insulating substance. The driving-wheels thus composed of electro-magnets, will not require to have flanges, as the four common wheels will retain the carriage on the line of rails. The series of magnets will be connected together by hard wood bolted through from side to side, care being taken that the magnets are not in metallic contact with each other.

In the prefixed figure, A,B,C,D, is a wheel of any convenient radius, composed of a series of electro-magnets. The ends of the magnets nearest to the centre are fixed into a wooden boss, and the whole of the magnets connected together by a frame of wood on each side, bolted together in a compact mass.

The mode of operation of the two magnetic or driving-wheels would be as follows:—The quadrant, AB, would be excited by positive electricity, and would attract the rails of the railway, and thus produce progressive motion. At the vertical point, B, the contact would be broken off, and the electro-magnets in the quadrant, BC, would cease to be in contact with the battery, and would consequently be inoperative.

The magnets in the quadrant, CD, would also be excited by positive electricity, and would attract the bar of iron, D, which would be a straight massive bar placed horizontally, and as nearly in contact as possible without actually touching, the periphery of the wheel.

At the vertical position the magnets would cease to act, and the quadrant, AD, would consequently cease to attract the bar, D, whilst receding from it.

By this means it is presumed that a progressive motion of considerable power would be obtained, as several of the magnets near the points B and D would be in almost close contact, and would consequently possess considerable power.

The carriage may be of the lightest possible construction consistently with the necessary strength, as there would be no occasion to increase the weight of the carriage for the purpose of giving the exquisite adhesion to the rails.

The attraction being between the periphery of the wheel and the rail, there could be no slipping.

ALEXANDER DOULL.

3, Euston Grove, January 18, 1848.

ON HEATING AND VENTILATION. BY H. M'CORMAC, ESQ., M.D.

The ill success that has attended most of our efforts for the perfect ventilation and heating of houses and public buildings, very sufficiently proves, that if there be a right way, we have failed to find it out. I do not mean to say that the method which I am about to propose is this right way; but I suppose I may be permitted to say, that it seems to me to be so.

We heat our rooms with open fires, stoves, hot-water apparatuses, at high and low pressure, steam. An open fire might almost be defined a contrivance to heat chimneys, but to cool rooms. The fire projects or radiates a certain amount of caloric into the apartment; but this the ravening fire instantly takes back again, in whole or in part, so long as it is kept up. If it be a good fire, to be sure, a small excess of caloric remains in the apartment, though by far the greater portion goes up the chimney. But only let the fire get low, or go out, and the apartment, if the weather be cold, grows chill directly; indeed, the chimney, so long as the least warmth remains in it, continues to extract the residuary heated air out of the chamber. As it is, the struggle goes on all day long. A fire is kept up perhaps sufficient to cook a sheep; the nose and the toes are roasted, while the back is cooled to the uttermost; and there is no such thing as sitting from the fire. I have heard Swedes and other northerns say, they never suffered such cold as in England.

Stoves heat the room finely; but the exemption from chill is dearly purchased by a close, unventilated apartment—a parched, and, if I may say so, singed atmosphere. It is evident, that neither of these modes furnishes us with pure, genial, moist air, free from filth, dirt, smoke, and ashes, as well as danger of fire. In my opinion, these desirable results may be economically and effectually realized; but, meantime, a few preliminaries:

First, I would lay it down as indispensable, that the supply of warm, moist, pure air, should be sufficient for our animal requirements, and our artificial wants in the way of lights and open fires, if any. *Second*, that this supply should come from below, and escape, when made use of, by proper apertures above, as well by the fire-places aforesaid.

For many years it has been apprehended—at first dimly, then more and more clearly—that it might be very possible, not only to introduce heated air into our apartments, but to introduce it fresh and fresh, as well as duly heated. It was distinctly propounded, in "Thomson's Annals," more than twenty years back, to make a chamber behind fire-places, to introduce the exterior air therein, and thence to emit it heated. This idea, whether borrowed from the "Annals" or not I do not pretend to say, was very felicitously turned to account by Mr. Murray (now deceased), of Polmaise, near Edinburgh. He introduced open air into an interspace attached to a brick stove covered with an iron plate, thence into forcing-houses, thereby producing admirable crops of grapes and other fruits. This system, called "Polmaise," formed the subject of many interesting articles in the *Gardener's Chronicle*. It occurred to me, that if it answered so well for grapes, it would do very well for men, women, and children; and that, if it succeeded in vineries and forcing-houses, it would do very well in human dwellings. After a good deal of consideration, and some few experiments, I thought an improvement might be made. I reflected on the mode of heating by the ancients: I thought their hypocausts, or *fires beneath*, might be turned to account. I opened Palladio, and read as follows:

"The ancients used to light their fire in a small furnace under the earth. Thence they conveyed a great many tubes, laid in the thicknesses of the walls and ceilings, into the different stories and rooms of the house. Each of these conveyed a warm steam or heat to dining-rooms or bed-chambers whenever they had a mind." These hypocausts appear to have been universally used by the Romans, at least in the colder portions of their dominions. Even to this day, they are discovered under the Roman houses, or the remains of them, exhumed in London, and elsewhere in Britain.

My proposal now is, in imitation of the Roman hypocaust, to establish a furnace or fire in some convenient portion of the basement storey, to form a hot chamber contiguous, into which the atmosphere should have access, and thence to convey the heated air, by means, say, of tubes in the wall, into the various passages and apartments of the house. I would have valves to regulate the ingress of atmospheric air into the hot chamber, and valves to regulate its exit into the different apartments. The kitchen-fire, with a sufficient cavity behind it, might

very probably be made to answer. The Romans, it appears, cooked at the mouths of their hypocausts.

If this practice were carried into effect, it would very agreeably heat our living apartments, as well as the various passages, stairs, and the like, leading to them. It would be exempt from all the discomforts and risks attendant on the present defective and expensive mode of heating houses. There would be neither smoke, dust, dirt, nor any kind of danger. Any room, or all the rooms together, might be comfortably heated at half an hour's notice. The air would be pure, soft, fresh, and moist; not burnt up like that heated, or rather burnt, by ordinary stoves; and the distressing indraught of cold air from doors and windows would be mainly done away with. Rooms, if people chose, could be constructed without fire-places; or, if with fires, small ones would suffice. Each fire-place also could be made with a cavity behind; in winter to heat, in summer to cool and ventilate the apartment. Every part of the room would be habitable; and, if tubes were arranged contiguous to the chimney-stack, so as to allow the foul and heated air to escape from the upper part of each apartment, the ventilation would be complete. The pure, fresh, moist, warm air, would find its way into the passages and each apartment below, while the impure, vitiated air would escape above. The present practice of admitting cold air into the upper part of our chambers, is attended with risk and inconvenience. The practice which I would inculcate of letting in pure air below and letting off the foul air above, is consonant with nature, cheap, efficient, and practicable.

The principle of warming houses with pure, fresh air, heated in a cavity above or behind a fire-place, is equally adapted to stoves with casings, steam tubes, and hot-water apparatuses: it is only needful to suffer the pure, fresh air to come in below, and go out heated above. It may be adapted to the common fire-place, to the common iron stove, and to the beautiful Flemish stove-grate; also to the Dresden and Russian stoves. At present they serve to heat, more or less perfectly, the same mass of ill-renewed air; but with a hot-air chamber attached, yielding admission to pure, fresh air below, and giving forth warm and moist above, it would convert the close and too often fetid apartment into one redolent with purity and freshness; thus imitating, in a small way, the beneficence of Nature, and ensuring health, cheerfulness, and warmth, in place of chill, discomfort, and disease.

H. M'Cormac, M.D.

Belfast, Feb. 6, 1848.

ON A NEW ANALOGY BETWEEN HEAT AND ELECTRICITY.

I have recently observed (what has doubtless been noticed thousands of times before) that when a thermometer is suddenly plunged into a fluid, or other body whose temperature is very different from its own, the *first* effect on the mercury is just the opposite of that which the relative temperatures afterwards produces. For instance, a thermometer, standing at 60° or 70°, being plunged into ice-cold water, the first effect is a sudden *dilatation* of the mercury,—to a small extent, however, and which lasts only for a moment. Similarly, if a thermometer at 50° or 60° be immersed in boiling water or steam, the first momentary effect is a slight *fall* of the mercury in the tube.

The analogy of these facts with the induced currents of voltaic electricity, is too obvious to need more than a mere reference, and depend, without doubt, on the same well-known mechanical causes to which I have already referred the latter in a former paper; namely, on the usual circumstances accompanying every sudden communication of motion from one body to another, or one elastic system of particles to another.

I perceive, also, that within the last year, Professor Henry, of America, has shown that heat added to heat may produce cold: and that, in France, Messrs. Fizeau and Foucault have shown, by means of the well-known experiment of the two inclined mirrors, that the calorific rays interfere in precisely the same way as the luminous rays. We shall not have much longer to wait for evidence of the interference of electric currents. It is rather strange, however, that no one has yet discovered reflection and refraction of electricity, or, as far as I have heard, even made the attempt.

A. H.

NORTHEN'S IMPROVED DRAIN PIPES.

[Registered under the Act for Protection of Articles of Utility. Mr. W. Northen, of Vauxhall-walk, Lambeth, Brown Stone Potter, Inventor.

Fig. 1.

Fig. 3.

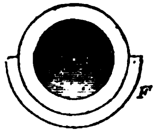
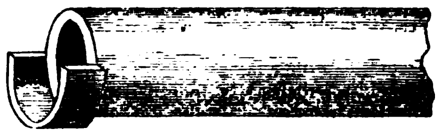


Fig. 2.



The evidence taken before the Metropolitan Sanitary Commissioners, has clearly established the great superiority of glazed stoneware pipes for purposes of drainage, over the ordinary brick sewers and drains. Whether *glass* pipes would not be still better, is a point that appears never to have been once mooted; owing, no doubt, to a prevailing impression that they must be so *costly* as quite to preclude their adoption. We are by no means sure, however, that this impression is well founded; considering, especially, the rapid progress which has been made since the abolition of the duty on glass in diminishing the cost of its production. By the patent processes of Mr. Bessemer (of which we hope shortly to be enabled to give our readers a full account) the time of melting the raw materials has been already reduced from *eighteen* hours to *three;* and a proportional saving consequently effected not only in time, but in fuel. Of course, if glass pipes could be furnished at as cheap a rate as stoneware pipes, they would be greatly to be preferred; for there is no property belonging to the latter which would not be possessed by the former in a still higher degree. The only objection taken to the stoneware pipes in the course of the evidence taken before the Metropolitan Sanitary Commissioners, was, the difficulty of getting into them, in the case of obstruction. "There is one inconvenience," says Mr. Newman, "in these pipes: in the event of a stoppage, I am obliged to break up two pipes to get to the obstruction; in a brick drain, removing two or three bricks will do it; therefore, in making repairs, the brick drains have this advantage."—*Min. of Evid.*, p. 115. We are happy to say, however, that within ten days of this objection being made publicly known, it has been removed. The "Minutes of Evidence" referred to, were published last week, and among the articles of utility registered during the present, is the improved form of pipe represented in the prefixed engravings, by which facilities of removal are afforded, such as even brick drains do not possess. The form is one, besides, which is equally applicable whether the pipe is made of stoneware or of glass.

Fig. 1 represents three lengths of this improved description of pipe. Each length has a half faucet, FF, on its two ends; as represented on a larger scale in perspective in fig. 2, and in the end view in fig. 3. Supposing fig. 1 to represent part of a continuous line of pipes, the half faucets of the pipes, A and C, are on the under side, while those of B are on the upper side. While this arrangement gives all the advantages of security against leakage possessed by the spiggot and faucet-joint, it admits of any one pipe in the series being lifted and replaced, without in the least disturbing the others.

REMINGTON'S IMPROVED MILLSTONE.

[Registered under the Act for the Protection of Articles of Utility. John Randolph Remington, Stafford, engineer.]

"We had the opportunity," says the *Staffordshire Examiner*, "a few days ago, of inspecting a pair of stones for grinding batches, which have recently been erected at St. Thomas's Mill, near this town. They have been erected under the superintendence of Mr. Remington, a most able engineer and mechanician from Alabama, one of the southern states of the American Union. These stones are only 17 inches in diameter. The upper stone is stationary—the lower one revolving; and surprising though it may seem, these small stones will do two or three times as much work as the large ones, four or five feet in diameter. We saw ground by this diminutive but powerful agency, four strikes of barley in twenty minutes, which would give twelve strikes in the hour: whereas, we believe, on the average, the old stones do not produce more than five or six strikes in the same time. Mr. Remington contends that great extent of surface is nöt necessary to produce amazing grinding capabilities; and we certainly think that he has practically demonstrated his position. It is probable that more power may be required to work the smaller stones for a given period; but there is a very great saving of power when the quantity ground is taken into consideration. Another great advantage of the small stones is, that they seldom or never require 'dressing.' Mills on this principle, we believe, are now in general use in Alabama, and when it is remembered how trifling is their cost, and how convenient they are for erection almost anywhere, it would be surprising if they were not generally adopted in England."

The cause of this superiority is surprisingly simple. Hitherto it has been usual to groove the faces of millstones in lines inclined the same way as that in which the stones revolve, as from *left* to right or *vice versâ*. Mr. Remington gives the grooves an inclination directly opposite to the direction of motion, and hence the greater grinding power which he realizes.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.*

(Continued from vol. xlvii., p. 410.)

VII. CONGENERIC EQUATIONS.

Let

$$F(x)=0\ldots\ldots\ldots\ldots(1.)$$

be an algebraic equation of the nth degree put under the usual form, and suppose that

$$F(x)=f_1(x)\,f_2(x)\,f_3(x)\ldots f_m(x);$$

then, *provided that the functions, f, do not involve negative powers of x*, no quantity other than a root of (1.) can satisfy any of the equations

$$f_1(x)=0, f_2(x)=0, \ldots, f_m(x)=0.$$

For, if possible, let y, a quantity which is not a root of (1.), satisfy the equation

$$f_1(y)=0\ldots\ldots\ldots\ldots(2.)$$

then one at least of the other functions [$f_r(y)$ for instance] must become infinite, otherwise y would satisfy (1.) contrary to hypothesis: but, the relation

$$f_r(y)=\pm\infty\ldots\ldots(3.)$$

gives

$$y=\pm\infty'$$

a value which does not satisfy (2.); hence (2.) and (3.) are inconsistent, and no quantity other than a root of (1.) can make any of the above functions vanish.

The next question that presents itself for consideration, is the possibility of determining, *à priori*, which (or if any) of the roots of (1.) will fulfil the condition

$$f_r(x)=0$$

f_r being any one of the functions f.

Let $x_1, x_2, ., x_n$ denote the roots of (1.) For greater simplicity we will first confine our attention to the case in which

$$F(x)=0$$

is a quadratic, and the factors into which it is decomposed (and consequently the functions f) are two in number. We will further suppose that A (vol. xlvii., p. 409,) and consequently x_1 and x_2 are real—which is in fact the case in the congeneric surd equations already partially discussed.†

In the equation

$$9x^2-44x+51=0,\ldots\ldots(4)$$

if we take (see vol. xlvii., p. 409,)

$$X=\left(3x-\frac{22}{3}\right)^2,$$

* At an earlier part of this volume (*supra*, pp. 19—20,) I have adverted to the exercises proposed at the conclusion of two of the papers of this series (I. and III.)

† See *Mechanics' Magazine*, vol. xlvii. pp. 410, 331—332, 151, and 135—136.

$$A=\frac{5^2}{3^2}$$

and also, $\beta=2x-\frac{43}{9}$

we shall have

$$f_1(x)=3x-7+\sqrt{2x-2}$$
$$f_2(x)=3x-7-\sqrt{2x-2}.$$

So, if

$$9x^2-60x+96=0,\ldots\ldots(5)$$

take $X=(3x-10)^2$
$A=4$
$\beta=30x-75$;

then we arrive at *

$$f_1(x)=3x-5+\sqrt{30x-71},$$
$$f_2(x)=3x-5-\sqrt{30x-71}.$$

The above differ from the expressions at p. 409 of vol. xlvii. no further than that the given quadratic is taken of the form

$$r^2x^2+a.rx+b=F(x)=0\ldots.(6)$$

and that

$$\left(rx+\frac{a}{2}\right)^2$$

is made equal to X.

In β let m be the coefficient of x^2 and n the part free fom x; also let x_1 be the greater and x_2 the less of the roots of (6), both being supposed positive; then when

$$X+\beta$$

is a perfect square, if

$$\frac{a^2}{4}+n-(r^2+m)x_1^2, \text{ or B,}$$

and

$$(r^2+m)x_2^2-\left(\frac{a^2}{4}+n\right), \text{ or C.}$$

be both negative the equations

$$f_1(x)=0 \text{ and } f_2(x)=0$$

may both be satisfied; but if those quantities have different signs, only one of these equations admits of solution. This I shall show in my next paper upon the subject, but here I shall merely apply the rule to the equations (4) and (5).

In (4) then we have

$$\frac{a}{2}=\frac{22}{3}, m=0, r=3,$$

$$x_1=\dagger 3, x_2=\dagger 1\frac{8}{9}, n=-\frac{43}{9};$$

hence

$$B=\frac{484-43}{9}-9\times 9=-32$$

$$C=9\times\left(1\frac{8}{9}\right)^2-49 \quad =-16\tfrac{8}{9}$$

Again, in (5) we have

$$r=3, a=20, m=0,$$
$$x_1=*4, x_2=*2\tfrac{2}{3}, n=-75,$$

and consequently

$$B=100-75-9\times 16=-119,$$
$$C=(3\times 2\tfrac{2}{3})^2-25=+39;$$

So, in the equation†

$$x^2-21x+54=0..(7)$$
$$r=1, a=21, m=0,$$
$$x_1=18, x_2=3, n=-\frac{185}{4};$$

whence

$$B=\frac{441}{4}-\frac{185}{4}-(18)^2=-260,$$
$$C=9-64= \quad -55.$$

In (4) and (7) B and C are both negative, hence each of the congeneric surd equations, corresponding to the values of β employed respectively in those two cases, can be satisfied:

But since in (5) B and C have different signs, the congenerics corresponding to the value

$$\beta=30x-75$$

cannot both be resolved.

Next let

$$3x^2-20x+32=0\ddagger\ldots.(8)$$

here

$$r^2=3, a=\frac{20}{\sqrt{3}}, x_1=4, \text{ and}$$
$$x_2=2\tfrac{2}{3}; \text{ let } \beta=x^2-8\tfrac{1}{3},$$

then, since

$$m=1 \text{ and } n=-8\tfrac{1}{3},$$
$$B=25-(3+1)\times 16=-39$$
$$C=4\times(2\tfrac{2}{3})^2-25=+3\tfrac{4}{9},$$

hence, B and C having different signs both the roots of (8) belong to *one* of the congenerics corresponding to

$$\beta=x^2-8\tfrac{1}{3}.$$

Those congenerics are

$$2x-5+\sqrt{x^2-7}=0$$

and

$$2x-5-\sqrt{x^2-7}=0.$$

* Some remarks on the two equations which follow will be found at p. 151 of vol. xlvii. of the *Mechanics' Magazine*; et vid. ib., p. 186.

† *Mech. Mag.*, vol. xlvii., p. 185.

* See *Mech. Mag.*, vol. xlvii., p. 186.

† Ib., pp. 185, 410.

‡ This equation is equivalent to (5).

Let*

$$4x^2-65x+259=0$$

and

$$\beta=x-\frac{129}{16}$$

then,

$$r^2=4,\ a=\frac{65}{2},\ m=0,$$

$$x_1=9\tfrac{1}{4},\ x_2=7,\ n=-\frac{129}{16};$$

and

$$B=256-4\times(9\tfrac{1}{4})^2=-86\tfrac{1}{4},$$
$$C=4\times7^2-256=-60;$$

and since B and C are both negative both the congenerics corresponding to β, viz.:—

$$2x-16+\sqrt{x-3}\quad=0,\dagger$$
$$2x-16-\sqrt{x-3}\quad=0,$$

admit of solution.

In the preceding instances we might have obtained the same results more speedily by the method of *trial*. But my object is to arrive at a general Theory of Surd Equations.

2, Church-yard-court, Temple.
January 22, 1848.

* This equation occurs in the solution of Example 21 of p. 135 of the fourth edition of Prof. J. R. Young's *Algebra; et vide ibid* pp. 131—132, where the preceding equation and its congenerics just arrived at will be found.

† On dividing this equation by 2 it becomes identical with that of the Example mentioned in the preceding note.

REVIEW OF THE EVIDENCE GIVEN BEFORE THE METROPOLITAN SANITARY COMMISSIONERS ON THE APPLICATION OF HYDRAULIC SCIENCE TO THE IMPROVEMENT OF THE SEWERAGE AND DRAINAGE OF TOWNS. BY THE REV. MORGAN COWIE, M.A., PRINCIPAL OF THE COLLEGE FOR CIVIL ENGINEERS, PUTNEY.

[From Minutes of Evidence taken before the Commissioners.]

I may observe generally on the results of the investigations which I have had an opportunity of considering, that their promulgation will be of a very high public importance, as they will promote a considerable and extensive advance in hydraulic science, and constitute the first great practical step towards the remedy of the evil of the defective drainage of our towns. I will first observe upon the evidence of Mr. Phillips, which I think highly important. I have read this evidence with peculiar pleasure; though Mr. Phillips disclaims being a scientific man, he shows that he is well acquainted with the scientific authorities on this subject.* The cases he discusses are extremely well explained, and the principles he employs, even where he disagrees with scientific writers, are, for the most part, stated with accuracy and distinctness. I have the honour to subjoin several remarks which occur to me, relating to this inquiry:—

1. As to *gauging*.
2. As to the *velocity* with which fluids will discharge themselves in pipes not kept constantly full, with different inclinations.
3. As to the *capacity* necessary for receiving and carrying off united streams.
4. As to the nature of the substance of the channel; what influence it has on velocity.

1. *The gauging.*

Complaints are made that the formulæ investigated by mathematicians and others do not give accurate results. I should ask, in reply:— *First*, How the *accuracy is tested? Second*, How was the experiment made for finding the data required in the formulæ? Mr. Phillips gives correctly the rules adopted (not from theory though by mathematicians, but from experiment) for determining the mean velocity when the surface velocity is known, except in the case of M. Prony's formulæ for finding the mean velocity (v) from the surface velocity (V),

$$v=V\frac{V+2{\cdot}37}{V+3{\cdot}15}\text{ in metres.}$$

Or in feet,

$$v=V\frac{V+7{\cdot}776}{V+10{\cdot}335};$$

in small velocities it would not be safe to take an approximation to this rule. The method given of finding the surface velocity is very rough, and depends for its accuracy

* We too have read with "peculiar pleasure" the evidence of this gentleman, who presents one of the most remarkable instances we ever met with of the successful "pursuit of knowledge under difficulties." We extract the following intersting piece of personal history from the "Minutes of Evidence," p. 42:—"Had you been employed on sewer work? (before being appointed Surveyor to the Westminster Court of Sewers)—No; excepting that many years ago I once worked as a bricklayer in the building of a sewer. Were you brought up to the profession of a surveyor?—No; I went to work *when I was eight years old*, as a bricklayer. I *never had the slightest education*. The little I do know I have taught myself, and that, too, under a succession of trying difficulties." What Mr. Phillips modestly calls a "little," is nearly as much as anybody knows of the subject on which he was examined; and much more than the generality of the educated men amongst us. His evidence displays throughout not only a thorough practical acquaintance with hydraulics, but a perfect familiarity with the scientific principles on which it is (or rather *ought to be*) founded.—Ed. M. M.

entirely on the dexterity of the observer. Several methods of finding velocities of currents are in use, but *all* are defective in some point or other. Woltman's Tachometer or Hydrometric-mill is the best. But in the case of sewage water, there may be difficulty in applying these rules. I therefore think Mr. Phillips has stated wisely that the best plan is to gauge directly by barring the channel, making an aperture of given breadth, and then calculating the velocity of the current from the ascertained discharge in a given time. Here, however, Mr. Phillips has unfortunately applied the formulæ, relating to waters discharged from a still reservoir, and not to waters arriving at the apperture *with a given velocity*.

The proper plan, on his own method, would be this,—bar the whole section by boaring it; let a rectangular slit be made whose breadth is *in feet* (l), and the height through which the water flows (H); let the breadth be small, compared with the breadth of the section, then the number of cubic feet discharged $= \frac{2}{3} (l \sqrt{\text{H}}) \times 4{\cdot}813$. So that by noting H, as Mr. Phillips proposes, we could find the quantity of water.

"The more accurate formulæ would require us to know (v) the mean velocity of the water; but this will have little influence unless (v) is considerable. Taking it into consideration, the quantity discharged in one second in cubic feet, would be,

$$\tfrac{2}{3} (5{\cdot}3)\, l\, \text{H} \sqrt{\text{H} + {\cdot}035\, v^2},$$

or

$$(3{\cdot}5)\, l\, \text{H} \sqrt{\text{H} + {\cdot}035\, v^2}.$$

In all cases where the formulæ are to be applied to large masses of water, I should give more close and accurate values to the coefficients, continuing them to several decimal places.

The present formulæ are derived from very accurate experiments made by M. Castel, Engineer of the *Etablissement des Eaux* at Toulouse.

Mr. Roe finds that Mr. Hawksley's tables, calculated, as I suppose, from his formula, give incorrect results. The formula in question, is for velocity of water through a *tube* of considerable diameter.

$$v = {\cdot}77 \sqrt{\frac{h\,d}{l + 1\frac{1}{2}\,d}}.$$

v = velocity in yards.
h = head of water in inches.
l = length of pipe in yards.
d = diameter of pipe in inches.

This reduced to the form where all the dimensions are given in *feet*, would be,

$$v = 48{\cdot}01 \sqrt{\frac{h\,d}{l \times 54\,d}}.$$

M. Poncelet gives a formula, investigated, I believe, by Navier, and which, when applied abroad, has given very accurate results, of which the following is the expression in English feet:

$$v = 47{\cdot}95 \sqrt{\frac{h\,d}{l + 54\,d}}.$$

This differs from Mr. Hawksley's, by such very small quantities, that I conclude both to be the same, and therefore that Mr. Hawksley's is correct, when correctly applied. Poncelet's formula gives very correctly the quantity of water which is furnished to the town of Metz from Scy, and therefore should not be at fault elsewhere; by the formula, the quantity of water delivered under a constant pressure as Metz in 24 hours, was calculated to be 262·656 C.M., and was found to be accurate within 2 or 3 cubic meters: in all these cases the tube is supposed to be constantly full.

2. As to the *velocity*.

In an open canal, the mean velocity being (v) in feet.

c, the wet contour.

s, the area of a section of the fluid

$\frac{s}{c}$, is the hydraulic mean depth.

g, the force of gravity.

$\sin i$ = sine of angle of inclination.

$$g \sin i = {\cdot}0035855 \frac{c}{s} (v^2 + {\cdot}02028 v).$$

These constants have been determined by Eytelwein from experiments made on 91 canals and rivers, involving considerable variation of veloeity and magnitude of section: and this is the accurate formula, from which the approximate common rule (of taking $\frac{10}{11}$ths of the mean proportional between the hydraulic mean depth and the fall in two miles) is derived.

The law connects the inclination with the velocity; and if the latter term be not neglected (which it generally is, to avoid trouble,) I feel confident it will give accurate results. It tells us at once what inclination we must have to secure a given mean velocity. I should observe, however, that this inclination is the inclination of the *surface of the fluid*, not of the bottom of the canal or tube. Eytelwein's great discovery was, that the velocity was independent of the latter inclination, and only depended on the inclination of the surface of the fluid in the case of canals and rivers.

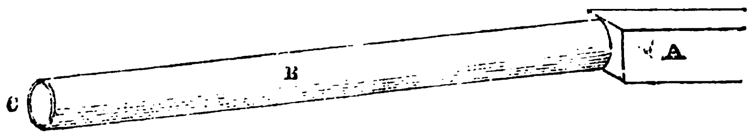
It is still, however, desirable to know how this formula is modified by the specific gravity of the fluid I am not aware that any experiments have been made to ascertain how it would be modified, at least, in

the case of large tubes. Du Buat, in tubes of small diameter, found that dirty water would not flow so fast as rain water, which we should have expected; but the diameter of his tube was so small, (five lignes,) that the results obtained are not sufficiently practical to guide us in this matter.

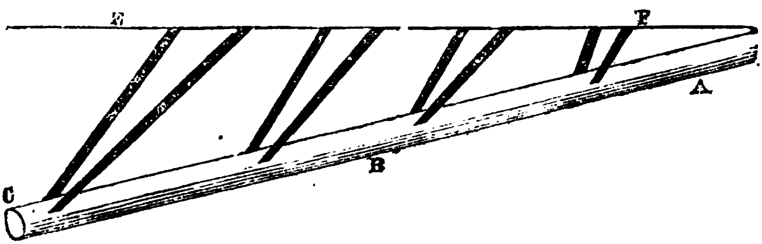
Mr. Phillips has calculated, by a formula which only agrees approximately with the true one, what velocity will be given by one of his egg-shaped sewers, of given dimensions, and given inclination, kept constantly full, and he finds that experience shows a much larger velocity; for he says that he has known larger areas drained by smaller conduits; so that he concludes, '*Absurdly large as practice demonstrates the present sewers to be, the theories would make them larger.*'

I think Mr. Phillips has not sufficiently considered the case.

The formula he calculates from refers to a canal conveying constantly the same body of water, and at the same velocity from one end to the other, and does not contemplate the constant addition of quantities of water, arriving with various velocities. The formula applies to a case like this:



The sewer B, leading from a reservoir A, where the height does not vary, to an out et C.



The case he tests the formula by, is like the figure above; one main sewer, from A to B and C, receiving in its course a number of smaller sewers, down which the water will rush from the upper surface with various velocities, increasing as we proceed from F towards E. In all these cases, the velocity of the water passing on from B to C will be increased. The water coming down A C and E C will have fallen through the same vertical height; and if it had fallen *freely* would have the same velocity; but the water down A C has been retarded by the friction along A C, and that down E C by the friction along E C; the former retardation will be greater than the latter, and therefore velocity less in the former than in the latter case. So that we not only have the velocity in A C variable (which is supposed in the formula to be uniform), but continued additions of masses of water with different velocities. It is clear, therefore, that the motion in A B C cannot be *uniform*, and therefore, that he has applied the formula to a case where it does not apply properly.

The reason, then, why Mr. Phillips finds theory at variance with practice, is this:—The velocity in the sewer will not be uniform, because the stream receives constant accessions, moving with different velocities.

I would calculate in the following way:—Suppose a sewer 5 miles long, with a fall from one end to the other of 200 feet, *i. e.*, a fall of 40 feet per mile, and suppose it to receive additions of water at every half mile by sewers of given dimensions, the water coming down these sewers will have fallen through 20, 40, 60, 80, &c., feet; and I should calculate the velocity with which each feeding sewer would bring its tributary waters into the main sewer, and calculate the continual acceleration, and so find at last the velocity at the outlet.

It is true that the mean velocity is uniform, when the resistance arising from the friction of the channel is equal to the accelerating force which gives it motion. But if the accelerating force is *greater* than the resistance arising from friction, the mean velocity is not uniform, but *accelerated*, and

we shall have a constantly increasing mean velocity from the head of the sewer to the outlet. I apprehend this is the case in practice. Not having Mr. Roe's gaugings, I cannot tell whether or no he has found an increasing mean velocity towards the outlet; but the facts would authorize one to say that it must be so.

Eytelwein's formula is inapplicable to this case: it refers only to an *open canal, where the mean velocity is uniform from the canal head to the outlet.*

I would further suggest, that in estimating the quantity of water to be drained over a given surface, no allowance is made for evaporation; so that the quantity of water being less than that which Mr. Phillips calculates would drain away, it is not surprising that he found smaller drains than those he calculated, carrying off the surface waters of a larger district. The evaporation must be very considerable in summer; but I cannot refer to any tables which give us the quantity of rain water which, in the course of the year, will be returned to the atmosphere in this manner.

In general, in short drains or sewers, it will be inconvenient to vary the calibre: in that case, we must calculate the necessary size of the outlet from the following formula, which I dare say agrees with Mr. Hawksley's, but which is taken from M. Morin's *Aide Mémoire de Mécanique Pratique*:

Q = cubic feet to be discharged per minute.

l = length of sewer.

f = fall in the length (l). All expressed in feet.

D = diameter of sewer in feet.

$$D = \cdot 04547 \sqrt[5]{\frac{Q^2 l}{f}}$$

This will give an accurate result in all cases where the velocity

$$\left(\text{which} = \cdot 0212 \frac{Q_2}{D}\right)$$

is not less than 2 feet per second.

3. It is a well-known principle in hydraulics, that if a tube be kept constantly full, the velocity will adjust itself so as to be inversely as the area of the section.

If, therefore, one end of a tube be open, there cannot be any necessity for enlarging it as it receives tributary streams in proportion to the sections of those streams. All that would be necessary would be to take care that the section was so large towards its extremity that the fluid should not attain a velocity which would injure the structure; and having given the maximum quantity of water to be conveyed by the sewer, we should see that the outlet size was large enough to convey this quantity with convenient velocity, and then gradually (at junctions where the tributary waters are considerable) reduce the section of the drain, proceeding upwards from the outlet. But if the final velocity were such as not to injure the work, or dam up the waters in small tributaries, I see no reason to increase the section from one end to the other of the ramified system.

If we could secure a constantly full sewer, discharging itself above high-water level, it would prevent the evolution of noxious gases to a considerable extent.

"The scouring power of water is very great. I believe Mr. Hopkins, of Cambridge, has calculated it to be as the seventh power of the velocity; but I quote from memory.

4. I am rather inclined to think, from general considerations, that the influence of the material of the channel, on the velocity, would be small. In most cases the tube gets *lined* as it were with a film of the fluid, which remains stationary, or nearly so, and in that case the only friction is the fluid rubbing against itself, the moving fluid against the stationary fluid. Mr. Roe has made experiments on this subject, which show a greater difference than I had anticipated in favour of glazed tubes; and it probably may be the case, that in 'mere dribbles,' as the streams are in many cases, the glazed tubes would have an advantage, because of their allowing no percolation or absorption.

But further experiments on such a point would be highly interesting and useful, as well as those referred to above on the rate of flow of fluids of different specific gravities.

THE COMING COMET.

Sir,—I venture to send you the results of some calculations which I have lately made relating to the comets which appeared in the years 1264 and 1556, and supposed to be identical bodies; if this be the case, the return of the comet to its perihelion must be now very close at hand. According to the Chinese observations, the appearance it presented in 1264 must have been very remarkable, "the length of the tail being 100°. The comet of 1556 did not appear in such splendour as at its former perihelion passage, but was nevertheless noticed by nearly all European astronomers. As both these apparitions took place before the invention of the telescope, observa-

tions of the comet could, of course, not be made with any great degree of accuracy, though, at the same time, they would be quite sufficient to compute approximatively the elements of the orbit; the similarity of those thus determined for the comets of the above years, is the basis of the calculations, which are made for an elliptical orbit. The comet's co-ordinates (a, y, z) were obtained from the following formulæ:

$$\log x = \log \sin \left\{ 9^\circ\ 36'\ 9.''\ 410 + v \right\} + 9{\cdot}999996 + \log r.$$

$$\log y = \log \sin \left\{ 279^\circ\ 35'\ 30.''\ 840 + v \right\} + 9{\cdot}9960496 + \log r.$$

$$\log z = \log \sin \left\{ 100^\circ\ 11'\ 10.''\ 017 + v \right\} + 9{\cdot}1281146 + \log r.$$

A table of the co-ordinates was thus computed, extending from perihelion to 100 days *before*, and combined with those of the sun, as given in the *Nautical Almanac*, on five hypotheses, differing ten days in the assumed time of perihelion passage. The comets co-ordinates, together with the log radii vectores, are exhibited in the Table below:

Days from P. P.	x.	y.	z.	log r.
0	+ 0·0795423	− 0·4732612	+ 0·0640313	9·6849796
− 10	− 0·2583039	0·4715612	0·0642715	9·7335964
− 20	0·5565812	0·3830785	0·0526947	9·8310516
− 30	0·8032185	0·2557124	0·0357761	9·9261876
− 40	1·0100411	− 0·1145803	+ 0·0169363	0·0071760
− 50	1·1881224	+ 0·0302254	− 0·0024416	0·0749994
− 60	1·3449709	0·1746159	0·0217926	0·1323986
− 70	1·4858849	0·3171379	0·0409127	0·1818158
− 80	1·6141145	0·4569459	0·0596825	0·2249502
− 90	1·7328996	0·5939961	0·0780923	0·2632010
− 100	− 1·8419216	+ 0·7280339	− 0·0961063	0·2973034

The hypothetical times of perihelion passage are

1 .... February 28, 1848.
2 .... March 9, ——
3 .... March 19, ——
4 .... March 29, ——
5 .... April 8, ——

Hence we have the following Ephemerides upon the different hypotheses of P. P. for enabling us to discover this Comet:

Hyp. I.	Right Ascension.			Declination.			Log. Δ.
Date.	h.	m.	s.	°	′	″	
February 8	18	43	22	− 11	39	21	0·0071550
—— 18	20	8	32	− 7	6	47	0·0479492
—— 28	21	26	15	− 3	25	33	0·1091617
Hyp. II.							
February 8	17	44	2	− 14	36	52	9·9450133
—— 18	19	15	38	9	28	13	9·9594181
—— 28	20	39	53	4	12	58	0·0177757
March 9	21	54	8	− 0	30	5	0·0924533
Hyp. III.							
February 8	16	37	44	− 17	39	20	9·9004243
—— 18......	18	14	6	12	58	26	9·8709043
—— 28......	19	50	12	6	18	11	9·9047568
March 9	21	12	20	− 0	37	44	9·9841613
—— 19	22	22	18	+ 2	46	54	0·0729604

Hyp. IV.	Right Ascension.			Declination.			Log. Δ.
Date.	h.	m.	s.	°	′	″	
February 8	15	27	12	− 19	56	1	9·8831854
—— 18......	16	57	36	17	5	35	9·8003835
—— 28......	18	47	41	10	2	48	9·7798724
March 9	20	28	7	− 1	49	26	9·8428119
—— 19......	21	46	21	+ 3	44	19	9·9474170
—— 29......	22	51	4	+ 6	25	42	0·0507347
Hyp. V.							
February 8	14	19	49	− 20	53	18	9·8948494
—— 18......	15	28	14	20	19	10	9·7710961
—— 28......	17	16	33	15	29	17	9·6665923
March 9......	19	31	46	− 4	50	19	9·6658860
—— 19......	21	11	18	+ 4	26	24	9·7745813
—— 29......	22	22	47	8	57	31	9·9082831
April 8......	23	20	53	+ 10	27	1	0·0257748

South declinations are denoted by the sign — ; north declinations by + ; Δ is the distance between the centres of the earth and comet.

JOHN T. BARBER.

Trinity College, Cambridge, February 11.

GLASS PIPES.

Sir,—In your Magazine of this day, in reference to the article on "Sanitary Reform," you mention Mr. Ellerman's suggestion of "glass pipes," and that no one has yet seen any such pipes, even in Paris, where it was supposed they were in use for water and gas. Some four or five years ago, M. Pelltier, a sulphuric-acid maker (I believe of Paris), paid us a visit, and, amongst other things, stated that he was enabled to see the state in which the nitrous acid gas passed off from his chamber by means of a *glass pipe*. This is the only one I have heard of, and I have made many inquiries of the glass manufacturers (at least, those who now make glass tiles, glass bowls, &c., &c.), and have been informed, that nothing has been yet perfected in this country in that way. If there had been, I should have adopted it for all pipes where either dry or wet acids travel, and where tinned copper pipes are now in use, but which perish eventually.

I am, Sir, yours, &c.
ANDREW BRANDRAM.

Rotherhithe, Feb. 12, 1848.

[We beg to assure our correspondent that he may obtain any number of glass pipes he pleases to order of Messrs. Coathupe and Co., Nailsa Glass Works, near Bristol, not exceeding 12 feet long, and of any diameter (we believe) from 1 to 12 inches. We have in our possession a couple of specimens, which we should be glad to show to Mr. Brandram. ED. M. M.]

INQUIRIES AND ANSWERS TO INQUIRIES.

Bullets in Elephants' Tusks.—"I have a piece of ivory, a portion evidently of an elephant's tooth, in cutting through which I came to a leaden bullet, closely imbedded in the heart of it, without there being the least trace of how it came there. The ivory all round it is perfectly sound and of a fine grain. How is this to be explained? And has such case ever been heard of before?—*M. M.*, Clerkenwell, Jan. 23." The finding of such bullets in elephant's tusks is nothing uncommon. Even gold and silver bullets have been found thus imbedded—shot no doubt from some imperial or princely gun. In the *Phil. Trans.* for 1801, there is a paper by Mr. Combe, in which he endeavours to explain how the orifice through which the bullet enters becomes closed. He supposes that the ball may enter at the root, descend into the hollow of the tooth, and become covered up by the growth of the layers which are successively developed upon the cutical vascular pulp.

Crickmer's Oblique Cylinder-engine.—"There is a mistake in your answer to a correspondent respecting this engine, p. 141. It was planned by me fifteen years ago, in order to work a steam-carriage. I placed the cylinders at the angle to do away with the frames, and, at the same time, to connect both cylinders upon the same crank. I never took out a patent for the arrangement, but purposely published it in your useful Magazine for the benefit of any persons who might wish to avail themselves of a simple double engine. At the same time, should any one make an engine on this plan, I hope they will at least do me the favour of allowing me a sight of it. —*Robert Crickmer*, Engineer. Spa-road, Bermondsey. February 7, 1848."

Medical Secrets.—"M.D." No one can have a

property in a medical recipe except by grant of Letters Patent. An obligation by a person not to divulge the secret of a particular composition, is one which no court has yet found itself able to enforce. James's Fever Powders, James's Analeptic Pills, and Velno's Vegetable Syrup, have all furnished cases in point.

Chain Cables.—"L. D. W." A chain of 56 lbs. per fathom is usually tested to bear a strain of 17 tons; but the weight of anchor allowed for, in the calculation is not more than 8 or 9 cwt.

Whitelaw and Stirrat's Water-wheel. — "A. M." We cannot promise our correspondent that either this wheel or the turbine of Fourneyron will do "much more work" than "a good overshot water-wheel;" but it is fit he should understand that the superiority of these wheels does not rest so much on their producing a greater per centage of useful effect, as their working well in situations where an overshot wheel could not work at all. The overshot water-wheel is limited to a range of fall of from 10 to 60 feet; but the wheels referred to are applicable to all falls from 2 feet to 200 and upwards. They work too equally well (nearly) whether wholly or partly immersed in the water. For a full description of Whitelaw and Stirrat's wheel, see *Mech. Mag.*, No. 1004.

Royal Steam Navy.—The regulations of this service were given at length in No. 1245. Good hands are much wanted at present. Age no objection.

Licenses.—"A Manufacturer." An actual license must be by deed under hand and seal; but any agreement for a license (similar to an agreement for a lease) on a half-crown stamp will be equally valid.

NOTES AND NOTICES.

Anastatic Printing.—"In conjunction with Mr. P. H. Delamotte, who has lately established an anastatic press in this city (under licence from the patentee,) I have recently been trying various modes of transferring pen etchings and tracings to zinc plates. Two days ago it occurred to me that drawings made *on paper* with *lithographic chalk* might be transferred, and printed from in the same manner. Yesterday morning I had a somewhat hasty sketch made with lithographic chalk, on common drawing paper (of good quality, but not very smooth surface), and sent it to Mr. Delamotte's press. An hour after, I received a proof similar to the one inclosed; which is a perfect *fac-simile* of the original drawing, and cannot be distinguished from a lithograph. Further experiments will be required to prove whether this method can supersede the finer branches of lithographic drawing,—or, in other words, whether paper can be made with a surface as finely and uniformly *grained* as that which is produced on the stone. But for less delicate and elaborate works there can be no doubt that the anastatic process has two advantages over lithography. First, we dispense with the cost and inconvenience of transporting and using heavy stones. The traveller may now fill his portfolio with sketches made in the field, with lithographic chalk on paper, and may afterwards print off as many copies of these sketches as he pleases. And secondly, the drawings do not require to be *reversed*, nor even recopied,—a great saving of the artist's time and labour."—H. E. Strickland, M.A. Oxford, Feb. 10. —*Athenæum.*

Testimonial to Dr. Clanny.—On Thursday, a testimonial of merit and esteem was presented to Dr. Clanny, of Sunderland, in the Athenæum in that town. The testimonial consisted of a large silver salver, bearing an appropriate inscription, and a purse, wrought of gold thread, containing 100 sovereigns—the whole the produce of a subscription which realised nearly £200. The presentation took place in the library room, in which a numerous and respectable company assembled. The rector of Sunderland was called to the chair, and Dr. Glover, of Newcastle, presented the testimonial. The doctor adverted to Dr. Clanny's claims as the originator of the safety-lamp; and whilst admitting that Sir Humphrey Davy and Mr. George Stephenson are entitled to great merit, contended that Dr. Clanny is entitled to the praise of having first conceived and carried into effect the construction of a safety-lamp. He also referred to Dr. Clanny's estimable qualities as a man, and his merits as a medical practitioner, particularly alluding to his researches on gas and the blood, which he said had earned for him a name that will not die. Mr. Rennie embraced the opportunity of stating what he knew relative to the origin of the safety-lamp, and corroborating Dr. Clanny's claim to the priority of the invention.—Dr. Clanny responded in suitable terms, thanking the various parties who had taken an active part in the proceedings, and speaking of the origin and progress of the safety-lamp.—*Newcastle Advertiser.*

Artificial Rubies.—M. Gaudin, of Paris, has succeeded in producing artificial rubies, which have all the character of the natural stone. His process consists in submitting to the flame of an oxy-hydrogen blow-pipe ammoniacal alum, with the addition of some grains of chromate of potash.

Test for readily Distinguishing Iron from Steel.—To distinguish iron from steel by a chemical process, take pure nitric acid, dilute it with so much water that it will only feebly act upon the blade of a common table-knife. If a drop of the acid thus diluted be suffered to fall upon steel, and allowed to remain upon it for a few minutes, and then washed off with water, it will leave behind a black spot. But if a drop of this acid be suffered to act upon iron in the same manner, the spot will not be black, but of a whitish-grey colour. The black stain is owing to the conversion of the carbon of the steel into charcoal, which thus becomes predominant; and iron being nearly free from carbon, can produce only a grey stain. The utility of this test is not confined to finished articles manufactured of steel, but its application enables the workman in iron and steel to ascertain also the quantity and uniformity of texture of unfinished articles.

The Wear of Cast-Iron Rails.—I have had an opportunity of ascertaining, in the case of a railroad over which 200,000 tons' weight were conveyed annually, during a period of eighteen years, (comprising the carriages and their loadings of coals in one direction—viz., 150,000 tons; and the empty wagons only in the other—viz., 50,000 tons,) that the mechanical waste from attrition was 1 lb. in every lineal foot of rail, (2 lbs. per foot of way,) or thereabouts, in the course of the time named, which is 587 lbs. per mile of road per annum, the rails being cast from cold-blast pig-iron. It may not be generally known, but I believe it to be true, that there is no chemical waste going on with rails in regular use—a certain degree of heat, occasioned by the loads passing over them, preventing oxidation. The wear of hot blast cast-iron rails will be considerably greater, and by breakage still more; it is, indeed, a very difficult matter to assign to them a competent weight and strength—one-half more metal would, I much doubt, scarcely be sufficient for the purpose. I do not think it has yet been satisfactorily shown what the loss in weight, by wear, of malleable iron rails is, but it cannot fail to be considerably less than those of cast-iron. It is, indeed, a fact well known, and supported by theory, that the more highly iron is wrought, and the purer it is rendered, by being purged of earthy dross in its transmutation from the crystalline to the fibrous state, the stronger and more durable it will be, whether as regards its subjection to the action of fire, to attrition, or mechanical stress—in the character of engine grate bars, wagon-way rails, tye bars, &c.—*Thompson's Colliery Inventions and Improvements.*

Fountains without Sewers.—"It is reported that, on the completion of the Cloaca Maxima of Rome, so proud was Tarquinius of the achievement, that he rode through it in his chariot in procession." But "now it is very much in the condition of too many of our own wretched sewers and drains, nearly choked up to the crown with deposit and filth, perpetually send

ing forth its bubbles of pestilential gas, and poisoning the neighbourhood. The supply of water that still exists in Rome—and it is now twelve times greater than what is given to this metropolis—being supplied only externally, the merest portion is devoted to domestic and cleansing purposes. The bulk of it plays its part at the beautiful fountains, then runs to waste, and the drainage being deficient, produces only dampness and decay."—*Mr. H. Austin, C. E.—Min. of Evid. Metrop. Sanit. Commission.*

"*Mechanics of Vegetation.*"—Mr. M. Noton, referring to the article by Mr. G. Woodhead under this title, which appeared in No. 1277, complains that it is but a repetition, with a slight change of form, of some peculiar views on the subject of "Light," "Heat," "Air," &c., by the same writer, which have appeared in former numbers of the Magazine, and were ably refuted by Mr. Thomas D. Eaton, of Norwich, in No. 1093, p. 43. We agree with Mr. Noton in thinking, that it would have been no more than fair, had Mr. Woodhead replied to Mr. Eaton before again pressing his notions on the attention of our readers.

WEEKLY LIST OF NEW ENGLISH PATENTS.

The Right Hon. Thomas, Earl of Dundonald, Vice-Admiral of the White squadron of Her Majesty's fleet, Knight Grand Cross of the Most Hon. Order of the Bath, for improvements in marine steam boilers and apparatus connected therewith. February 11; six months.

Horatio Black, of the town and county of the town of Nottingham, lace-maker, for improvements in evaporation. February 14; six months.

John Watson, merchant, and Edward Cart, gentleman, both of Hull, for improvements in the manufacture of gas. February 14; six months.

James Timmins Chance and Edward Chance, of Birmingham, for improvements in furnaces, and in the manufacture of glass. February 14; six months.

William Tottie, of Crosby-square, London, merchant, for improvements in distilling. (Being a communication.) February 14; six months.

John Weston, of Portland-town, Middlesex, machinist, for certain improvements in obtaining and applying motive power. February 16; six months.

Joseph Barber Haxby, of Dewsbury, for improvements in making communications between the guards, engineers, and other servants in charge of railway carriages, and also between the passengers and such servants, which improvements are applicable generally where speedy and certain communications are required. February 16; six months

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Feb. 11	1350	James Batch Cox and Josiah Stanton......	Falmouth, ironmonger; and Gerrans, Cornwall, builder..	Improved chimney-top.
,,	1351	George Twigg	Birmingham..........................	Button.
,,	1352	Bedford and Rand	Oxford-street	Lady's saddle.
14	1353	Henry Jackson...........	Little Love-lane, Cheapside	Cravat.
,,	1354	Smith and Co.	Fell-street, Cheapside	Bombule, for medicinal purposes.
,,	1355	Antoni Forrer............	Regent-street, artist in hair and jewellery	Hair guard, necklace and bracelet protector.
16	1356	William Davidson	Thomas-place, Gravel-lane, engineer................................	Improved fire-escape.
,,	1357	W. Northen	Vauxhall-walk, Lambeth, brown stone potter	Improved stone-ware pipes.
,,	1358	John Warner and Sons,	Crescent, Cripplegate, engineers,	Improved fan or spreader, for fire and garden engines.
,,	1359	Robert Davies	Blue Cross-street, Haymarket...	Cigar and pipe tube.
17	1360	Samuel White............	Broad-street, Golden-square, cap manufacturer	Hat stretcher.
,,	1361	Ebenezer Cha. Browne,	St. Alban's, Hertfordshire, assurance agent, &c.	Improved pan or vessel for holding milk.

NOTICES TO CORRESPONDENTS.

W. O., on Mr. Gray's "Logarithmic Tables," deferred for want of room till our next.

N. N. L.'s plan is no doubt substantially the same as that to which he alludes as having recently attracted much attention; but as it was confessedly kept private, no claim of priority can be founded upon it. We do not, therefore, see that any good purpose could be served by its publication.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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Edited by J. C. Robertson, 166 Fleet-street.

LEWTHWAITE'S PATENT NUMBERING MACHINE.

Fig. 9.

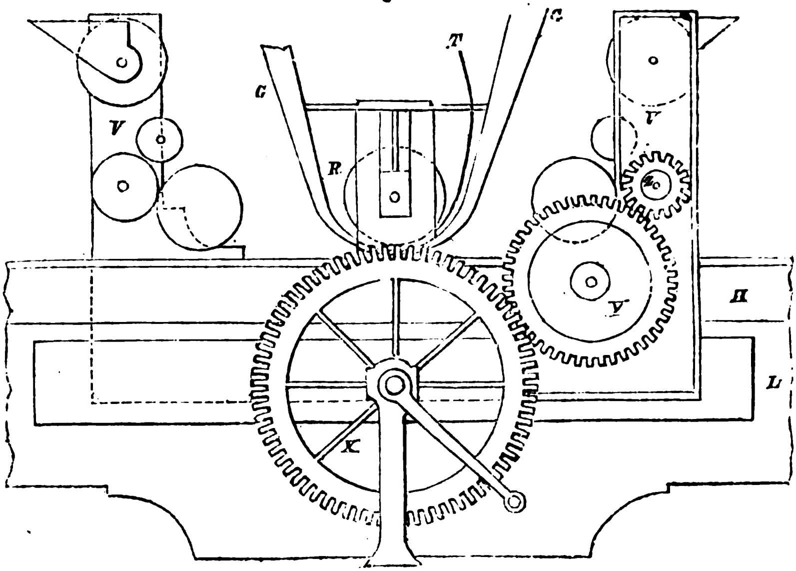
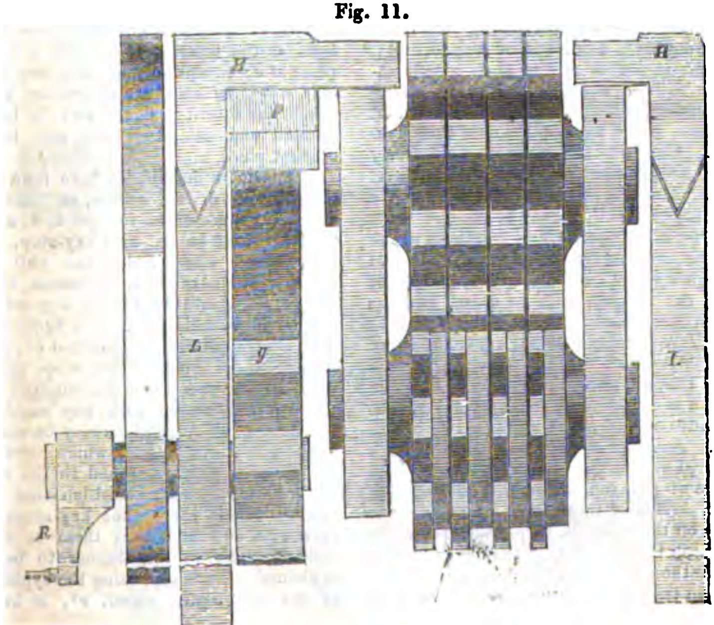


Fig. 11.



LEWTHWAITE'S PATENT IMPROVEMENTS IN NUMBERING MACHINES.

[Patent dated July 23, 1847. Patentee, John Lewthwaite, Halifax. Specification enrolled January 23, 1848.]

The present patent embraces various improved modes of constructing, placing, and adjusting the numbering and driving wheels of the machines used for numbering railway and pawnbrokers' tickets, paging books, and other like purposes, and certain improved modes or means of regulating the action of the same, whereby such machines are enabled to imprint numbers in any consecutive or alternating or other serial order which may be desired, in a more ready and effectual manner than is thought to have been ever before accomplished. We extract the following description from the patentee's specification:

Fig. 1, is a side elevation of what I call a "figure wheel" detached from the other parts of the numbering machine; it has ten cogs, on the ends or faces of which are the ten figures from 0 to 9, either punched out or let in, in relief. The number of these wheels employed in one machine may vary according to the extent to which the consecutive or alternating or other serial number is desired to be carried. Fig. 2, is an edge view of four such wheels attached to one shaft, A, which supposing the numbers to be imprinted in the natural sequence, would together number from 1 to 9999. Each wheel is made to turn freely on the axis, A, independent of all the others. Fig. 3, is a side elevation of what I call a "driving wheel," there being one such wheel for every figure wheel employed in the machine. It carries ten cogs, the same as the figure wheel; but these cogs, instead of being flat at their ends or faces, like the others, are made of a concave form, as shown. A circular portion, a^1, is cut out of the body of the wheel, so as to leave a round rim, a^2, all round, except at b, where the rim is cut through for a space equal to the width of the space between two of the cogs. Fig. 4, shows four such wheels mounted on one axis, B, to correspond with the set of four figure wheels, represented in fig. 2. Each of these driving wheels turns freely on the axis, B, independently of the others, in the same way as the figure wheels. When these figure and driving wheels are fixed in the machine, they are so placed in respect to one another that the cogs of each driving wheel shall take into the spaces between the cogs of the corresponding figure wheel; so that motion being given to any one of a set of driving wheels, it shall transmit that motion to its corresponding figure wheel, and the motion of these two wheels be independent of all the other wheels, excepting only in the special case or cases afterwards provided for. Fig. 5, is a side view of a key-stop, which is employed to regulate the movements of each driving wheel, there being one such key-stop for every wheel, and all the key-stops required for any set of wheels being attached to one bar, C, on which they vibrate, or rise and fall freely, independently of one another, except as is afterwards shown. Fig. 6, is an edge view, and fig. 7, a plan of five such key-stops applied to one axis. When fixed in the machine, these key-stops are so placed in respect to the driving wheels, that whether any one of the driving wheels is by some rotary or other movement brought into contact with its corresponding key-stop, or that the key-stop is by some similar movement brought into contact with its driving wheel, the effect shall be, to cause the driving wheel to move a distance of one cog, and no more, round its axis. These key-stops are all of the form shown in fig. 5, that is, of a pointed and somewhat conical form at the wheel end, m, with a bracket piece at e; except only the key-stop for the unit wheel of each set of driving wheels, which, (as shown in figs. 6 and 7), has the pointed end cut short off, and has no bracket piece, e.

Supposing a machine to have four figure wheels, four driving wheels, and four key-stops, (as represented in figs. 2, 4, and 6,) then c^1 would be the unit key-stop, c^2 the unit driving wheel, and c^3 the unit figure wheel. The next set in succession, marked d^1, d^2, d^3, would be the ten key-stop, the ten driving wheel, and the ten figure wheel. The next adjoining set, marked e^1, e^2, e^3, would be the hundred key-stop, the hundred driving wheel, and the hundred figure wheel: and so on with any number of wheels and key-stops which may be mounted in one machine. The bar which carries the key-stops is firmly attached to the bed of the machine in such a position that as the driving wheels revolve the key-stops shall take into and act upon them at certain fixed intervals, in the manner to be next explained. Thus supposing the cypher cog of the unit figure wheel, c^1, is brought

Fig. 1.

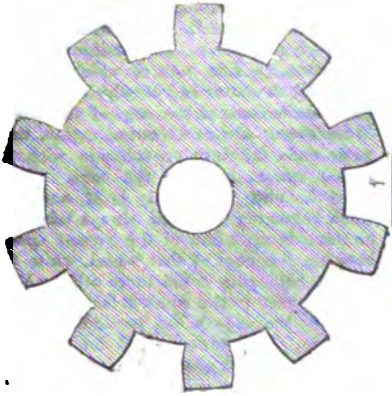


Fig. 2.

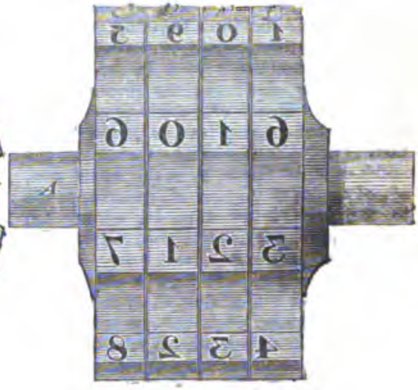
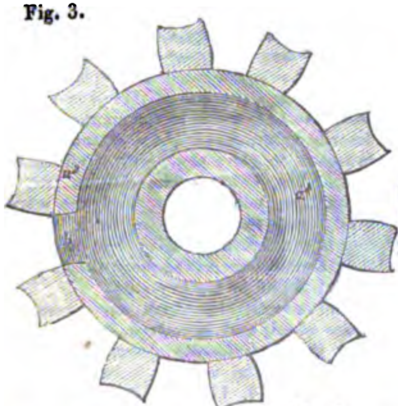


Fig. 3.



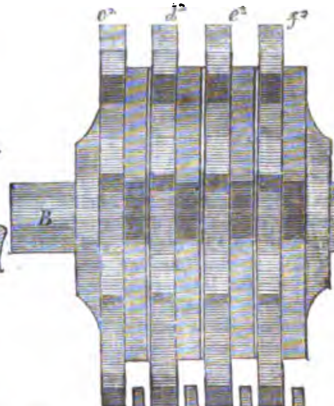


Fig. 4.

Fig. 5.

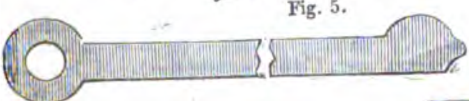
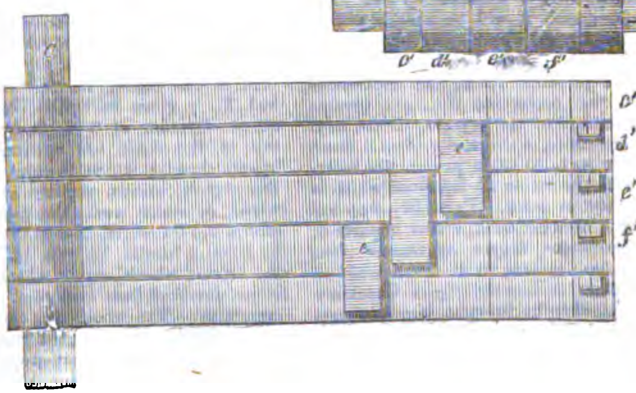


Fig. 6.

Fig. 7.



into any position required for printing, then the driving wheel, c^2, will by successive actions of the flat-faced key-stop, c^1, upon it, cause the figure wheel, c^3, to exhibit and print the numbers 1 to 9 in regular sequence. By continuing the revolution of the driving wheel, c^2, the cypher cog is brought round again into its primary position, but simultaneously therewith the notch or open space, *b*, in the raised rim, a^2, of the driving wheel, c^2, comes opposite to the pointed key-stop, d^1, of the ten series, when the conical end, *m*, of that stop enters the notch, and brings its flat shoulder part, *n*, into such a position in respect to the ten driving wheel as to move it round one cog, when the combination of the unit and ten figure wheels will exhibit the number 10. The ten figure wheel, d^3, now remains stationary till the unit figure wheel, c^3, has made a second revolution and exhibited a second series of the numbers 1 to 9, when the notch, *b*, once more presents itself, and the conical end of the key-stop, d^1, dropping into it, causes the ten wheel, d^2, to be once more acted upon, as aforesaid, and to exhibit the number 2. And so the operation goes on till the combination of the two sets of wheels and key-stops, c^1, c^2, and d^1, d^2, exhibit the number 99. The notch, *b*, in the ten driving wheel is then presented to the conical end of the key-stop, e^1, of the hundred set which brings that set next into operation, to play the same part in relation to the ten set which the ten set did in relation to the unit set. When by the combination of the three sets of key-stops and wheels the number 999 has been reached, the conical end of the thousand key-stop, f^1, drops into the notch, *b*, of the hundred driving wheel, e^2, and brings the thousand driving wheel, f^2, into play in the same manner as the others. The operation then goes on as before, until the number 9999 is attained. From what has been stated, it will be readily understood that in all positions of each of the driving wheels, except that only when the notch, *b*, presents itself, the continuous part of the projecting rim, a^2, presses against the end of the key-stop of the next adjoining driving wheel and pushes it down out of the way, so as to prevent its interfering with the action of the wheel which is immediately in work. Each key-stop has a spring, *s*, attached to it, which imparts to it the requisite degree of reaction, the moment the pressure on it is removed, as the numbers on the ten figure wheel are only required to be brought into use once in each successive revolution of the unit wheel, and the same is the case with the hundred wheel in relation to the ten wheel, and with the thousand wheel in relation to the hundred wheel. Each wheel is held fast during its period of inaction by means of a catch, (a side view of which is given in fig. 8,) the outer end of which takes into the concave faces of the cogs of the wheel. When these catches are out of action, their outer ends fall into or coincide with the vacant spaces between the cogs. Thus, when the unit wheel only is at work, the catch belonging to it will always take into or coincide with one of the vacant spaces between the cogs of that wheel, while the catches belonging to the three other wheels will each rest in the concave face of one or other of the cogs of its particular wheel. The ten, the hundred, and the thousand driving wheels are each released in succession, in manner before explained. The brace-piece, *c*, of the ten key-stop projects over the hundred key-stop, and that of the hundred key-stop over the thousand key-stop, (all as represented in the plan, fig. 7,) so that when any one of these key-stops is pushed out of action in the manner already described, the brace-piece attached to it causes it to carry along with it all the following key-stops. The catches (fig. 8) serve also not only to bind the wheels firmly and to keep them from shaking during the act of printing, but to prevent them from being moved more than one cog at each action of the key-stop.

The manner in which any number of figure wheels and key-stops, such as have been thus individually described, may be made to act in unison, is exemplified in figs. 8, 9, 10, 11, and 12. Fig. 9, is a side elevation of a numbering machine of five sets in its complete state, including the printing appendages (as to which last, however, I claim nothing new). H, is a chase, or frame, which carries the whole of the numbering parts, with the exception of the stops and slides in V, grooves on a bed, L, on which it is made to move to and fro by means of a rack, *p*, and wheel, *q*. A top plan of the chase, H, as resting on the bed, L, is given in figure 10, and a sectional elevation of it in figure 11. The top of the chase has openings, KK, in it, up through which the number cogs of the figure wheels slightly project. The wheel, *q*, which works the rack, *p*, which moves the frame, H, to and fro, is worked by a crank handle, R. Fig 12, is a plan of the driving wheels, figure wheels, and key-stops, detached from the other parts of the apparatus. The wheels are carried by the frame, H (as shown in the sectional elevation, fig. 11,) but the key-stops are perma-

nently attached to one end of the bed, L. Fig. 8, is a side view of the driving and figure wheels, showing how they gear one into another; those marked W^1 being the driving wheels, and those marked W^2, the figure wheels. From these figures it will be seen that the wheels are so geared as to produce a simultaneous action on all the sets. G, G, (fig. 9,) are feeding tubes, by which the paper or other material on which the figures are to be printed is supplied to the machine and conveyed between the printing roller, R, and the top of the figure frame, H. As soon as printed it is discharged from the opposite sides of the roller, R, in the direction, T. The inking of the projecting figures of the wheels, W^2, is effected by means of suitable rollers mounted in the frames, V, V, (one of which is shown in section in fig. 9); and these wheels are put in motion by the series of toothed wheels, X, Y, Z; the first of which is attached to the same axis as that which carries the rack wheel, q. In the machine just described, only five sets of figure wheels and driving wheels, with one set of key

Fig. 10.

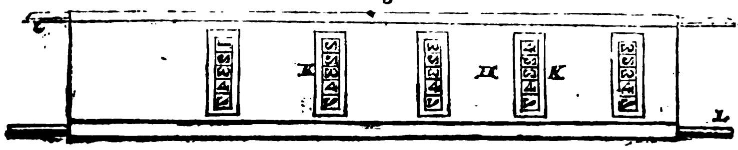


Fig. 12

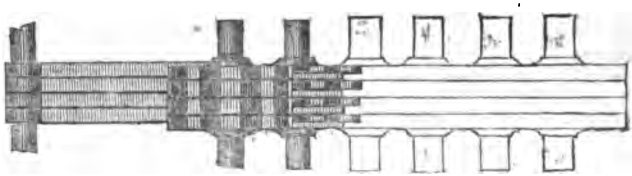
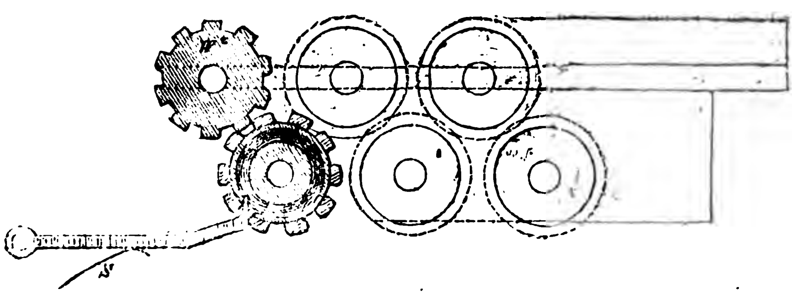


Fig. 8.



stops, are employed; but I find it preferable in practice to use ten sets, and to arrange the unit wheels in a sequence from 0 to 9. With the fig. 1, on each of the ten wheels, I get numbers from 10 to 19; with the next change the numbers from 20 to 29; and so on; the figure wheel always remaining stationary. But in order to effect this (supposing the numbers are to be printed in the natural consecutive order), it is necessary that the key-stops should be moved laterally till the unit key-stop is withdrawn from acting on the unit driving wheel and made to act on the ten driving wheel, which then becomes the unit driving wheel in respect of all the subsequent changes. But should it be required that each figure wheel shall commence with a different number from the others, or that separate portions of the series of natura

numbers shall be exhibited simultaneously, then the ten stops must preserve their original position; and this rule will hold whether the number of wheels in the machine is ten, fifteen, twenty, or any greater number. When a machine of this description is employed to page account-books, and others, in which case it is requisite to exhibit first all the odd numbers of the unit wheel for the purpose of figuring all the right-hand pages, and next all the even numbers for the left hand pages, and *vice versâ*, I accomplish this by adding to the unit key-stop, c^1, a supplementary prong, o, (as represented in dotted lines in fig. 5,) placed at a distance before the principal central end, m, equal to the breadth of one of the cogs. Every time this double key-stop acts on the unit driving wheel it moves two cogs instead of one as before, so that according as the wheel may be adjusted at starting, the key-stop will cause it to exhibit only odd or even numbers. All the other key-stops will, of course, act as usual. Instead, also, of each figure wheel exhibiting on its cogs the numbers in the natural sequence, they may be exhibited in any order which may be desired: and further, instead of the usual Arabic numbers being used, letters may be substituted for them, according to the Roman method of notation, or any other signs or symbols substituted expressive of numbers.

ON THE LAW OF ATMOSPHERIC RESISTANCE.

Sir,—In the previous essay on the resistance of atmospheric air, (current vol. p. 31,) I mentioned that in applying the formula to calculating the resistance in the case of rapid motions, if great precision should be required, two or three corrections would be necessary.

I now proceed to make a few remarks on this subject, with a view more especially of pointing out the existence of certain causes, which will of necessity occasion a difference or discrepancy between the results of experiments and the corresponding results as given by calculation from the formula.

The first I shall notice is *friction*, that is, friction produced by the particles or atoms of the air amongst themselves, occasioned by their being put into motion by the pressure of the plane.

Every theory of the resistance of atmospheric air founded on the considerations of its pressure and density, supposes that the plane strikes those particles which are immediately in front of it, that these particles strike the next, and so on. But this is supposed to take place entirely without friction; friction not entering in any shape into the calculation. Very little consideration is necessary to show that this cannot be a true view of the case; for if it were, the particles of air once put in motion would continue in motion *ad infinitum;* which is contrary to experiment, a very short time only being necessary, after the cessation of the cause which puts it in motion, before the air resumes its natural state of quiescence. It is likewise contrary to analogy to suppose that the particles of air move on each other without friction, as friction takes place in a very obvious manner, not only when solid bodies move on each other, but also when the denser fluids, such as water, oil, &c., are put in motion.

Dr. Hutton tells us in his 36th Tract, (art. 43,) that comparing the numbers expressing the resistances of the two hemispheres, moving with their bases against the atmosphere, it appeared that, at the same velocity, the larger hemisphere experienced greater resistance in proportion to the area of its base than the smaller one. And he observes also, that as the velocity increased the difference of resistance increased more and more in favour of the larger hemisphere. He then gives an approximate rule for estimating what increase of resistance might be expected to take place in the case of other similar bodies of different dimensions under the same circumstances; and remarks that by the same rule, the resistance to a smaller body might be deduced from that of a larger one found by experiment, at the same velocity. Whether the rule be strictly correct or not does not concern our present purpose, but it is evident from the doctor's experiments, that the velocity being the same, the less the surface the less proportionally will be the resistance. The doctor remarks in the next paragraph, that in the slow motions used in his experiments, the resistance to the same body is nearly on the average as the 2·04th power of the velocity; that is with bodies of the *same dimensions* as those used in his experiments. But as the resistance to surfaces of smaller dimensions decreases more rapidly than their areas, therefore the resistances in

these cases being less and less, the exponent of the velocity expressing the ratio of the resistance will likewise be less. Therefore there is no reason for supposing that with a surface of very small dimensions at small velocities, the ratios of the resistances will vary perceptibly from the squares of the velocities by which they are produced.

If we consider the case of a plane of considerable dimensions moving through the atmosphere, it will be obvious that those particles of air which are struck by the plane near the middle of its surface will not have the same facility of escaping from the pressure as those which are struck by it nearer its edges. Now as fluids, when not otherwise restrained, press equally in all directions, therefore the air near the middle of the plane will press upon the air nearer the edges, and force it into more rapid motion than what would be due simply to its own relative share of the pressure. This lateral pressure of the air near the middle of the plane would therefore occasion a corresponding divergence in the motion of the air nearer the edges: the whole mass of intercepted air would consequently escape in every direction comprised between the line of motion and the surface of the plane. The pressure of the air would therefore be greatest and the velocity least at the middle of the plane, while at the edges the case would be reversed; the pressure decreasing and the velocity increasing from the middle to the edges of the plane. Here then we have particles of air at the middle of the plane moving comparatively with slow velocity, and moving at the same time in contact with other particles nearer the edges of the plane, which last are consequently moving with greater velocity than themselves;—the result must be some degree of friction amongst the particles of air thus put into unequal motion.

By way of further illustrating this subject, let us consider the case of two *similar* planes, the linear dimensions of one being just double those of the other; the larger one will of course contain four times the area of the smaller one, and will by its motion displace four times the quantity of air at the same velocity. But the perimeter of the larger one being only double, and the air escaping in all directions (but principally laterally,) will have to escape with comparatively *greater velocity*, and consequently with *greater friction* than in the case of the smaller plane.

These considerations sufficiently, I conceive, account for the circumstance that a larger surface experiences comparatively a greater degree of resistance from the atmosphere than a smaller one, and likewise gives us the reason why even at slow motions the resistances increase in rather a more rapid ratio than the squares of the velocities; viz., that it is the friction of the particles of air amongst themselves, from being put forcibly into motion by the action of the moving body, which occasions the increase of resistance here spoken of.

But if the friction amongst the particles of air increases the resistance so perceptibly in cases of bodies moving through the atmosphere with slow motions, it must of necessity greatly increase the resistance to bodies moving with great velocities,—such as military projectiles. It is not however meant to be understood that this friction is the principal, much less the entire cause of the great increase of resistance, (above the ratio of the square of the velocity,) which is experienced by bodies moving with great velocities. Such a supposition would be entirely at variance with the theory of atmospheric resistance which it is the present object to establish.

Another difference betwixt the resistance at great velocities, determined by experiment, and the estimated resistance calculated from theory, will be occasioned by the increase of temperature which atmospheric air exhibits on being rapidly and forcibly compressed. In the previous essay I noticed that when a plane moves through the atmosphere with considerable velocity, the air immediately in front of it would be compressed: the degree of compression is there supposed to be directly in proportion to the pressure to which the air is subjected; and another term is introduced into the formula, on that supposition, to account for the increase of resistance incident to the increase of density. But the law in question, that the density of atmospheric air is directly in proportion to the pressure to which it is subjected, is well known to be true only when the temperature remains the same. Now when the air is suddenly compressed by a body mov-

ing through it with considerable velocity, the heat cannot possibly escape with anything like the rapidity with which it is evolved: the consequence is that the heat reacting on the air itself from which it is evolved, must necessarily prevent it from arriving at that state of density which would otherwise be due to the pressure in case the temperature had remained unaltered. The air therefore being less dense than supposed by the theory, will of course offer less resistance. The match-syringe affords an illustration of the effect produced by the sudden compression of atmospheric air, which must be familiar to almost every one. The late Doctor Dalton is I believe the first, if not the only, philosopher who has attempted to assign the degree of heat given out by the compression of atmospheric air, and the degree of cold produced by its rarefaction. The doctor's essay, to which I allude, is published in the "Manchester Memoirs," vol. v. (old series.) Dr. Dalton concludes from a series of experiments (given in detail in the essay alluded to), that by suddenly doubling the pressure on atmospheric air, the temperature will be raised very nearly 50° Fahr. And he observes that from his former experiments, a change of 50° effects a change of nearly one-tenth in the bulk of atmospheric air. It does not appear that Dr. Dalton carried his experiments beyond the pressure of two atmospheres (that is, one atmosphere above atmospheric pressure), so that we are left in uncertainty as to the increase of temperature that would be produced at three, four, or more atmospheres. That an increase of pressure, beyond the pressure used by Dr. Dalton would be attended with an increase of the intensity of the heat, admits not of the slightest doubt; but whether the intensity of the heat evolved is directly as the pressure, is by no means so clear. Judging from analogy, the probability is that the temperature would increase in a much more rapid ratio than the pressure. To assist in forming a correct idea of the effect of the increase of temperature here noticed, it will be well to refer to the actual pressures due to different velocities, as given by the formula:—observing, that it is the pressure in *front* of the plane or the *positive* pressure with which we have at present to deal. The formula gives for a velocity of

Feet.		per sq. in.
1,000	per sec., the positive pres.	8·2 lbs.
1,500	,, ,,	18·5
2,000	,, ,,	32·8:

these pressures being independent of the additional resistance produced by the increase of density. Supposing the temperature to remain unaltered, the relative densities of the air (the air in its ordinary state being taken as 1,) will be as follow:

At 1,000	ft. per second,	1·55	atmospheres.
1,500	,,	2·25	,,
2,000	,,	3·23	,,

Whatever may be the law of the increase of temperature, with regard to the increase of pressure, it is sufficiently clear from these calculations that the increase of temperature in great velocities will be proportionally more rapid than the increase of the velocity with which the plane moves. Or in other words, that the increase of temperature incident to the increase of pressure will have the effect of reducing the resistance very materially in great velocities.

Dr. Hutton, in his 37th Tract, (art. 17,) gives a table of the resistance of the air to a ball 2 ins. diameter. It is remarkable on examining this table, that the exponent of the velocity, indicating the ratio of resistance, goes on increasing till the velocity reaches 1,500, or 1,600 feet per second; after which it gradually decreases. This anomaly is noticed by Dr. Hutton, in the 19th and 20th articles of the tract in question; but particularly in the 20th, in which the Doctor uses the following word: "After the 1,600 feet velocity, where the exponent (2·153) is the greatest, it gradually decreases to the end."

Now I think it will be conceded that this anomaly is sufficiently accounted for by the consideration that the temperature of the air must of necessity be much increased at great velocities, in consequence of the compression which it undergoes; which increase of temperature diminishing the density, diminishes likewise the resistance which the ball would otherwise meet with, in case the temperature underwent no alteration.

I submit, therefore, that the anomaly here noticed furnishes a strong corrobo-

ration of the truth of the theory of the resistance of atmospheric air, which it is the object of the present essay to assist in establishing.

In like manner, as the air in front of a plane in motion is compressed, so likewise must the air immediately behind it be rarefied. Now as the rarefaction of air occasions a diminution of temperature, this diminution of temperature will have the effect of increasing what may be called the *negative* pressure, or partial vacuum behind the plane, tending to impede its progress forwards.

There is also another phenomenon attending the motion of bodies when moving through the atmosphere with great velocity (such as military projectiles,) which is that they are generally, if not universally, preceded by a mist, or appearance of vapour in a visible form. This is precisely what takes place when air is compressed in the receiver of the pneumatic apparatus called a condenser, and therefore affords a proof, if any were wanting, of the compression of the air in front of the moving body. That it is vapour (existing in the atmosphere in an invisible form), which, being reduced by the pressure to the form of minute drops of water, occasions the appearance cannot be doubted. Dr. Hutton, in the essay before alluded to, observes, that when vapour is condensed heat is given out. This circumstance would therefore tend to increase the temperature of the air in front of the moving body, and so far have a tendency to diminish the resistance: but the moving body having to encounter the vapour in such a dense form, it seems reasonable to suppose that on the whole, vapour in the atmosphere has a tendency to increase the resistance.

On revising the formula for rapid motions, given in the previous essay, I have reason to think that it is not sufficiently correct, and in lieu thereof now give the following; viz.:

$$p = m \times \sqrt{\frac{m}{14{\cdot}7279}} - n \times \sqrt{\frac{14{\cdot}7279}{n}}.$$

Which, I believe, is nearly correct for *all* velocities; the numbers and letters indicating the same quantities as in the previous essay. I am, Sir, yours, &c.,

JOHN POTTER.

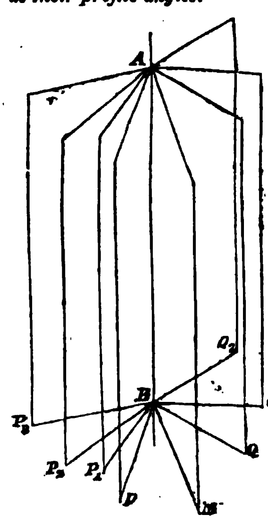
Charlton-on-Medlock, Feb. 14, 1848.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 130.)

PROP. XXX.

Dihedral angles are to one another as their profile angles.



Let AMP, AMQ be two dihedral angles, and MBP, MBQ their profile angles, then AMP, AMQ will have the same ratio as MBP, MBQ.

For in the plane PBQ, in which BM also lies, take any number of angles PBP_1, P_1BB_2, P_2BP each equal to PBM; and any number QBQ_1, Q_1BQ_2, each equal to QBM; and through AB and the lines BP_1, BP_2, BP_3, BQ_1, BQ_2 draw planes.

Then, since the profile angles MBP, PBB_1, P_1BP_2, P_2BP_3 are all equal, the corresponding dihedral angles are all equal (*prop.* 29.); and hence, whatever multiple the profile angle MBP_3 is of MPB, the same multiple will the profile angle AMP_3 be of AMP.

In the same way, whatever multiple the profile angle MBQ_2 is of MBQ, the same multiple is the dihedral angle AMQ_2 of AMQ.

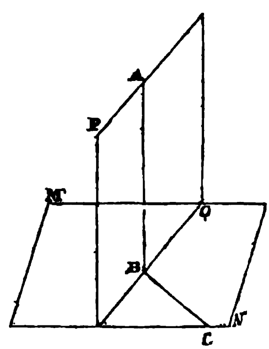
Also, if the profile angle MBP_3 be greater than MBQ_2, the dihedral angle AMP_3 will be greater than AMP; if equal; and if less.

We have hence the four magnitudes, the profile angles MBP, MBQ and the dihedral angles AMP, AMQ; and there are taken any equi-multiples of the first and third, and any of the second and fourth: and when the multiple of the first is greater than that of the second, the multiple of the third is greater than that of the fourth; when equal, equal; and when less, less. When the first is to the second as the third is to the fourth. (*Euc. v. def.* 5): that is,

$$AMP : AMQ :: MBP : MBQ.$$

Prop. XXXI.

If a line be perpendicular to a plane, every plane drawn through it will be perpendicular to that plane.



Let AB be a line perpendicular to the plane MN: then every plane, as MN, drawn through AB will make dihedral right angles with MN.

For through B draw BC in the plane MN perpendicular to the intersection BQ of the two planes.

Then, since AB is perpendicular to the plane MN it is perpendicular to the lines BQ, BC in it (*prop.* 24.), and BC is perpendicular to BQ by construction. Whence the lines BA, BC are drawn in the planes PQ, MN perpendicular to BQ their intersection; and hence ABC is the profile angle of the dihedral angle PQ, MN. Also, the angle ABC is a right angle, and hence the dihedral angle itself is a right angle. The plane PQ is, therefore, perpendicular to the plane MN; and the same may prove for every other plane through AB. Whence the proposition is true.

Prop. XXXII.

If from a point in one of two planes a line be drawn perpendicular to the common section, it will be perpendicular to the other plane; and if from a point in the first plane a line be drawn perpendicular to the second plane, it will lie wholly in the first plane and be perpendicular to the common section.

(*Preceding figure.*)

(1). Let the planes PQ, MN be perpendicular to one another and meet in BQ; and from any point A or B (without or in the line BQ) let a perpendicular AB be drawn to BQ in the plane PQ; the line AB will be perpendicular to MN.

For, in the plane MN draw BC perpendicular to BQ.

Then, since AB, BC are drawn from the same point B of the line BQ, (one in each of the planes PQ, MN,) ABC is the profile angle of the dihedral angle MNPQ. But, by hypothesis, the dihedral angle is a right angle, and hence the profile angle ABC is a right angle; or AB is perpendicular to BC.

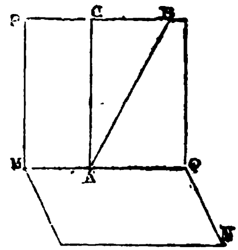
AB is also (*hypoth.*) perpendicular to BQ; and therefore being perpendicular to the lines BC_1 BQ_1 it is perpendicular to the plane MN which contains them.

(2.) Let PQ_1 MN be two planes at right angles to each other, intersecting in MQ, and A any point in PQ (but not in the common section MQ): then if

from A, a perpendicular be drawn to MN, it will lie in the plane PQ and be perpendicular to MN.

For, if possible, let the perpendicular not lie in PQ, but meet the plane MN in some point B. Draw AC perpendicular to MQ.

Then, by the preceding case AC is perpendicular to MN: wherefore from the point A two lines AC, AB can be de drawn perpendicular to the same plane:—which is impossible. (*prop.* 26, *case* 2.)

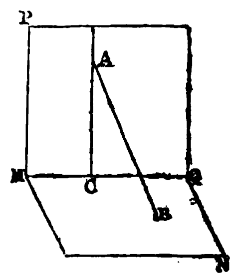


If the point A, therefore, be not in the line MQ, the perpendicular will fall wholly in the plane PQ; that is it will coincide with AC. Also, since AC is perpendicular to the plane MN it is perpendicular to the line MQ in it, which passes through C.

(3.) Also, if the point A be in the intersection MQ of the planes, the perpendicular from to MN will fall wholly in the plane PQ, and be perpendicular to MQ.

For, if possible, let AB the perpendicular not fall in the plane PQ. Draw AC in PQ perpendicular to MQ.

Then by the first case, AC is perpendicular to MN; and hence from the same point A, in the plane MN two lines AB, AC can be drawn perpendicular to that plane, MN:—which is impossible. (*prop.* 26, *case* I.)



Whence the perpendicular from A cannot but fall in the plane PQ, and, as in the preceding case, must coincide with AC.

(*To be continued.*)

CURIOUS ELECTRICAL PHENOMENA.

We are indebted to our correspondent, Mr. John T. Barber, of Cambridge, for the following notice of some curious electrical phenomena, which Mr. B. thinks have not been noticed before:

If a piece of paper be placed upon a smooth table, and then rubbed pretty smartly with India-rubber, the electricity which is developed is so powerful that two or three goose-quills may be made to adhere to the under side of the paper *after* it has been raised above the table. By the same means I have charged a Leyden jar, and given a powerful shock, which extended to the shoulders. If two pieces of paper be used, one being placed over the other, and treated in the same manner, and drawn asunder in the dark, they will produce a striking effect. *No* electricity is manifested until the paper is separated from the table, or from the substance with which it was in contact when rubbed. If done upon an insulated plate of metal, a spark of an eighth of an inch may be obtained after the removal of the paper; the only thing necessary is perfect *dryness*, but there is certainly something depending upon the quality of the paper. Silk may be used just in the same manner.

There is deposited in the Portsmouth Dockyard a working model of a "peril indicator," to denote the approach of ground to ships and steamers—the invention of Lieut. Westbrook, R.N., of the *Stag* revenue cruiser, on the Ryde district. The apparatus is positively too simple to describe; it is fitted to the keel of the vessel, and consists of a projection therefrom of two bars, 10 feet below the keel of the vessel; immediately these bars, which are fitted forward as well as aft, touch the ground, they spring up level with the keel and ring a large bell in the engine-room, which is the signal for the engineer to instantly reverse the engines, and send the ship astern. The invention has met with the approval of some of the members of the Admiralty, and every scientific, naval, or other person who has seen it.—*Portsmouth Paper.*

MR. GRAY'S LOGARITHMIC TABLES.

Sir,—I have to offer a few observations upon the subject of Mr. Peter Gray's paper published in your last Number, my information upon which is derived entirely from that and his former ones, published in your periodical, not having read either of the papers in the *Mathematician*.

Mr. Hearn's Table for computing anti-logs. is also applicable to the computation of logs. and superior to that given by Mr. Weddle and himself for the purpose, because it substitutes *additions* for *subtractions* and allows of some abbreviations:

As an example, required the log. of 3,1415,9265,3590

3,1415,9265,3590	× 3
9,4247,7796,0770	06
5654,8667,7646	
9,9902,6463,8416	09
89,9123,8165	
9,9992,5587,6581	
6,9994,7911	74
3999,7023	
9,9999,9582,1515	
417,8485	ar. com

Log. 3	=	4771,2125,4720	
Col. 1 06	=	253,0586,5265	
Col. 2 09	=	3,9068,9250	
Col. 3 74	=	3213,6603	
Col. 4 41	=	17,8061	
Col. 5 78	=	3388	
Col. 6 48	=	21	
		5028,5012,7308	
ar. com.	=	4971,4987,2692	= required log.

Originality cannot be claimed either by Mr. Hearn or Mr. Weddle, as a reader of Young's Essay *on the Computation of Logarithms* will perceive; the principle of the method is to decompose a number into simple factors whose logs are tabulated, which was done by Mr. Manning, in a paper published in the *Phil. Trans.* for 1806, and of which an account is given in the work above named. Mr. Manning's factors were $\frac{9}{10}$, $\frac{99}{10}$, $\frac{999}{1000}$, &c., and his only operation—placing a number beneath itself farther to the right, and subtracting; an example by him would occupy more time and require many more figures than one by Mr. Gray, but he uses but 12 primary logs. instead of 600.

If we take as factors $\frac{11}{10}$, $\frac{101}{100}$, $\frac{1001}{1000}$, &c., subtractions become additions, and many figures are saved, as, if a factor $(1+a)$ enters n times we may use the binomial theorem, $(1+a)^n$.

I give an example of Mr. Gray's, and therefore not a picked one, in which about the same number of figures are written as in his. I do not trespass on your space to explain the working of the example, which can be followed by any one who understands the subject:

Required the log. of 2,7182,8182,8459

$$(1+a)^3 = 1 + 3a + 3a^2 + a^3$$

2,7182,8182,8459	+3
9060,9394,2820	1
906,0939,4282	
9967,0333,7102	03
29,9011,0011	
299,0110	
997	
9996,9643,8220	
2,9990,8931	3
2,9991	
1	
9999,9637,7143	
299,9989	03
3	
9999,9937,7135	
62,2865	ar. com.

co. log. 3	=	5228,7874,5280	
log. 1·1	=	413,9268,5158	
3 log. 1·001	=	13,0223,2437	
3 log. &c.	=	1,3028,1831	
3 log. ,,	=	130,2882	
6 log. ,,	=	26,0574	
2 log. ,,	=	8686	
2 log. ,,	=	869	
8 log. ,,	=	347	
6 log, ,,	=	26	
5 log. ,,	=	2	
		5657,0551,8092	
ar. com.		4342,9448,1908	= log. required

In conclusion; although any one possessing Mr. Gray's Tables will gladly avail himself of their assistance, it is evident that without much additional labour the same results may be obtained with but a few logarithms tabulated; the principle of both methods is the same, and is due to Mr. Manning. W. O.

Islington, February 14, 1848.

Note by the Editor.

It will be perceived that in the preceding ingenious paper the author shows the applicability of Mr. Gray's Table to the finding of logarithms. This Mr. Gray did not show in his paper. But in a note, dated the 7th instant, he informed us he had discovered its adaptation to this purpose, and requested space to show it. Up to the time of receiving the foregoing paper we had not replied to Mr. Gray's note, and in then doing so we thought it fair to mention that a paper had come in, in which the adaptation in question was shown; and also claims to the origination of the method put forth in behalf of Mr. Manning. We subjoin Mr. Gray's reply, which we trust will render further discussion unnecessary. His method is totally different from that of W. O., but we do not feel called upon to offer an opinion as to the comparative merits of the two.

Mr. Gray, to the Editor.

My Dear Sir,—Many thanks for your obliging note. Without farther preface I give you an example of my method of applying the Table at pp. 158, 159, to the finding of logarithms.

```
                                3·14,159,2,65359,0 | 3 × 104
                                3 12               |
                                ----               |
          3 1 2)                  2 159            | 69
              1 8 7 2             1 872            |
                                  -----            |
                                    287 2          |
                2 8 0 8             280 8          |
          -------------           -------          |
          3 1 4 1 5 2 8)           6 4 65359       | 20
                    6 3            6 2 83056       |
          -------------           ----------       |
         ,3,1,4,1,5,9,1)            1 82303 0      | 580289
                                    1 57079 6      |
                                    ---------      |
                                      25223 4      |
                                      25132 7      |
 477121254720 | log. 3                -------      |
  17033339299 | 04                       90 7      |
   2986340857 | 69                       62 8      |
      8685803 | 20                       ----      |
       251891 | 58                       27 9      |
           87 | 02                       25 1      |
           39 | 89                       ----      |
 ------------ |                           2 8      |
·497149872696 | =log. required.           2 8      |
```

I shall be glad to find that your Correspondent's method differs from mine, and not very sorry if it shall turn out to be better. Let us by all means have the best that the case admits of. I should think it is about a month since I communicated the above process to our mutual friend, Mr. Woollgar, and to others besides.

I have been for several years acquainted with Mr. Manning's method, as described in *Young's Essay on the Computation of Logarithms*. In an artificial point of view, Mr. M.'s resolving process is a very beautiful one; but it is so exceedingly operose as entirely to preclude the idea of setting up in behalf of his method a claim to be considered as a *practical* one. It was as possessing this character, it will be recollected, that I presented Mr. Weddle's method to the notice of your readers; and therefore it was, I suppose, that whatever affinity may subsist between the two methods, it did not occur to me to name Mr. Manning's. Mr. Weddle himself, however, is sufficiently explicit. His words are,

(*Mathematician*, Nov. 1845, p. 25,) "The process of art. 4 [the *resolving* process] was suggested by perusing in the work alluded to, art. 2, [Young's Essay, just cited,] Mr. Manning's ingenious method of computing logarithms, (*of which it may be accounted a modification*,) and this led me to consider the converse problem."

There is then, avowedly, a community of principle between the two methods. Mr. Manning's is, in fact, the prototype of Mr. Weddle's. But it is just such a prototype as would present itself, if one were to propose, in order to the division of one number by another, to make as many subtractions as there are units in the sum of the quotient figures, instead of the process usually employed for the like purpose, which requires only the same number of subtractions as there are of quotient figures: which will be, on an average, in the ratio of 9 to 2. I do not know that Mr. Manning has any claim on the anti-logarithmic process of either Mr. Weddle or Mr Hearn.

I am, My Dear Sir, yours very truly, P. Gray.

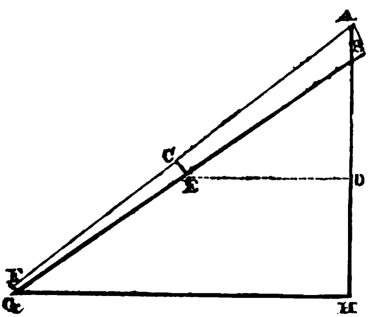
London, 37, Baker-street, Feb. 15, 1848.

ON THE CONSTRUCTION AND VENTILATION OF SEWERS. BY WILLIAM BRIDGE, ESQ., C.E.

(Continued from page 177.)

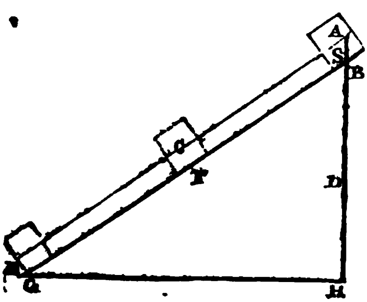
To proceed with the investigation of the case proposed in my last, namely, that of the flow of water, assuming it to be free from friction and all other extraneous

Fig. 1.



impediments: let fig. 1, represent the water, flowing down the inclined plane BG, and fig. 2, an incline, down which a solid slides. In the first of

Fig. 2.



these figures at right angles to BG, draw the line, AB, equivalent to the area of the fluid at B, and from A let fall the perpendicular, AH. By transposition of equation (1.) $= \frac{Q}{V} = \frac{Q}{C\sqrt{H}}$; therefore, $FG = \frac{Q}{C\sqrt{AH}}$, and to any intermediate point, E, in the line of descent, $CE = \frac{Q}{C\sqrt{AD}}$; therefore since the area of section of the water diminishes as it approaches towards the bottom, we shall by drawing the surface line, ACF, obtain the actual inclination of its path, which being steeper than the bed, BEG, the velocity generated is greater than that acquired by the solid, (fig. 2,) whose centre of gravity passes along the line, AE, parallel to the inclined plane. This action is that to which Mr. Cressy refers in the following:

Page 141.—"I come now to the propositions of Guglielmini, in which he pretends that a body descending an inclined plane will not acquire a velocity greater than it would have acquired by descending perpendicularly the height of the inclined plane.

"This is most true as respects solids: the elements of a solid being bound and tied together form a heavy mass, the parts of which press each other reciprocally; and the pressure on the plane on which they rest is likewise single, as also is the direction; one velocity, one energy, one action being common to all parts. On the other hand, a fluid is a mass composed of lesser solid elements, but free, and not bound together by any ties, each of which can so to speak

move in different directions, and with varying velocities press upon each other and oscillate freely. * * * * A solid descending an inclined plane has a velocity equal to what it would have falling through the same height directly. * * * * But in fluids the case is different. Besides the properties which they possess in common with solids, they have another, to wit, the pressure exercised by the upper on the lower part of the fluid; the which being added to the impact generates a greater effect than a solid would."

It is the inclination of the surface of the water that generates the velocity, and when there are no opposing forces to retard the flow, it is proportional to the square root of the vertical distance through which it has passed. The area of section depending on the velocity (the quantity being constant), it follows that whatever may be the variation in the dimensions of the channel through which the water flows, the law above noticed can in nowise be departed from. From the above observations it would follow that no reduction in the vertical section of the stream (fig. 1) at any point, say CE, would increase the velocity of the flow, for the speed at that part is already as great as is due to the full fall from A to C, and cannot be further increased. And so also it would follow that if a similar stream were added at the section CE, the velocity would not be increased, though the section of the conjoined stream would be doubled.

But this is contrary to every-day experience of the flow of water in open canals; for example, water flows more rapidly between the piers of a bridge than it does either above or below this contraction. If the water descend against the piers of a bridge with a velocity due to the full height of the head of the river, no acceleration in passing between the piers of the bridge could take place; for the velocity of the water is already as great as the fall can give, and therefore it cannot be further increased. It is the friction from the bed and sides, and other extraneous impediments which the stream meets with in its course, which lessens the velocity due to the vertical distance through which the stream has passed; this force when the stream comes to a reduction of section is again restored to it, the water behind the obstruction swelling until it is heaped up to a sufficient height above the ordinary level of the stream to give the water an adequate velocity to pass the obstruction, and thus cause the quantity delivered past any section to be equal in equal times.

A fluid is influenced by a dynamical force in the direction in which it flows, and a statical pressure upon its bed proportional to the depth of the stream passing along. This is also true with respect to the motion of a solid; for there is a force in the direction in which it moves, and a pressure on the surface over which it passes, giving rise to friction, &c. But the motion of a fluid differs from that of a solid from the facility with which any impediment to the former disturbs its equilibrium, causing the statical pressure of the stream to be in a measure unresisted, and thereby transferring it into a dynamical force accelerating the flow, or on the other hand with equal facility transferring the dynamical force into a statical pressure.

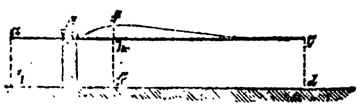
The friction along the bed of a stream increases with the velocity until it becomes equal to the acceleration, when the motion of the stream becomes uniform. The effect of friction is to reduce the velocity of a stream, and consequently to increase its sectional area; but it in nowise reduces the force of the stream. If the velocity is lessened, that force which produced the velocity is, so to speak, converted into an inate statical pressure. The reduction in speed increases the depth of the water, and consequently the pressure on the bed, which is proportional to the depth of the stream, and is in equilibrium with the surrounding water; but as soon as any reduction in the section of the channel is made, the statical equilibrium is destroyed, and this unresisted pressure increases the velocity to pass by the reduced section. Thus the friction reduces velocity; it does not lessen the force of the stream, but reserves that force by damming back the stream, and thereby enables it to put forth its energy, like the fly-wheel in a steam-engine, when circumstances demand it.

If H be the vertical height of the head of a river above the level of the sea, $V = C\sqrt{H}$ would be the velocity at which it would join the sea, were it not for the

friction along the bed, and sides and other opposing forces, which the river meets with in the course of its length; these impediments reduce the flow to the uniform velocity, $v = C\sqrt{h}$, and consequently the velocity lost by friction, &c., is $V - v = C(\sqrt{H} - \sqrt{h})$. But the area of section increases in the same proportion; for if A be the area of the stream with the velocity V, and $V = nv$, then nA is the area with the velocity v, and the increased statical pressure of the section, nA, is equivalent to the force lost by reduction of velocity, and were the channel again reduced to A, the velocity would become $= V$.

Suppose a, b, c, d, (fig. 3,) to be the longitudinal section of a stream. If

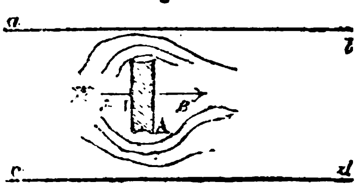
Fig. 3.



there were no resistance besides the friction along its bed, it would, after the water had acquired an uniform velocity, flow onwards at the same depth, *ac*, *bc*, *bd*, but if an impediment existed at A, to reduce the section of the current, the water would swell behind it until it had risen to a vertical height, *fb*, above the ordinary level of the stream, sufficient to increase the velocity past A inversely proportional to the reduction of section at that part.

The result will be the same whether we consider the water to flow past an impediment, or whether the water be stationary or a mass moving through the water. We will, for the sake of simplicity, take the latter case: therefore let *abcd*, (fig. 4,) be

Fig. 4.



a sheet of still water; A, a mass moving through it in the direction of the arrow. When the mass is stationary, the statical forces on both sides, *e* and *f*, are alike equivalent to the depth of the water; when however A moves in the direction of the arrow, this equilibrium is destroyed, the pressure on the side, *f*, is lessened, and that on the side, *e*, is increased, and the water would flow in the direction of the curved lines. The motion of A would continue to be accelerated until the difference of pressure between the sides, *e* and *f*, and the friction of the water flowing from *e* to *f* was equal to the moving force; after which the motion of A would become uniform. The relative velocity with which the water passes A, would be to the velocity of A as the sectional area of the water is to the sectional area unoccupied by the mass, A. Thus if S is the area of the water; *s*, the area of the mass, A; $v =$ the velocity of A; and V, the relative velocity of the water passing A; then

$$S - s : S :: v : V = \frac{vS}{S - s},$$

but we see above, that

$$V = C\sqrt{H} \text{ or } H = \left(\frac{V}{C}\right)^2:$$

whence the differencein level between the points *c* and *f* is

$$= \left(\frac{vS}{C(S - s)}\right),$$

which corresponds very nearly with the formula given by Du Buat; which is,

$$\left(\frac{v^2}{58{\cdot}6} + a\right)\left(\left(\frac{r}{m}\right)^2 - 1\right)$$

when a is the sine of the angle of inclination, which in the above example $= 0$, and r and m respectively represent S and $S - s$ and 58·6 is the constant quantity represented by C^2. Substituting these values in Du Buat's formula, it becomes

$$\frac{v^2}{C^2}\left(\left(\frac{{}_1S}{(S - s)}\right)^2 - 1\right);$$

the reduction of the unit in the second part of the formula being the result of experiment.

Since these observations apply equally to a body moving in still water as to any movable body in flowing, they serve to explain how it is that the impediment to the motion of a boat is greater in a narrow and shallow than in a deep and wide canal.

(*To be continued.*)

MR. DOULL'S ELECTRO-MAGNETIC WHEEL.—THE "NEW ANALOGY BETWEEN HEAT AND ELECTRICITY."

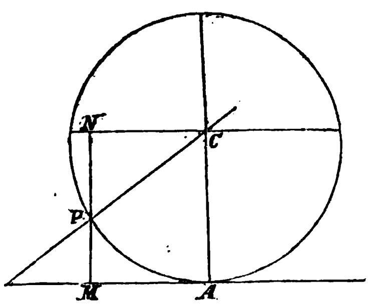
Sir,—In your last Number I observe a proposal by Mr. Doull for obtaining motive power by electro-magnetism. Without intending to discourage your correspondent, I cannot help endeavouring to point out how he appears to have overlooked the difficulties, and overrated the advantages of his plan:

1. The usual mode of imparting any considerable magnetic power to soft iron requires the bar to be surrounded by a coil of wire, which will take up a considerable space, and separate the magnets in the wheel to some distance from each other.

2. Your correspondent appears to forget that the attractive force of the rail, or bar, upon the magnet will be in a direction *perpendicular to the rail and not to the magnet.*

In consequence of this, it will be seen that the magnetic attraction when most powerful will be acting in the worst possible direction for the production of rotary motion.

Thus, let CP be the magnetic *spoke* angle PCA $=\theta$. Draw NPM through P, and perpendicular to the rail: then



if F be the force with which the attraction will turn the wheel, it is represented by

$$\frac{\text{CN}}{\text{PM}^2}$$

$$\text{or } F = k. \frac{\sin.\theta}{\text{versine}^2\theta}$$

where k is the magnetic force at distance unity from the rail. Hence the magnets near A would hardly exert any useful effect, whereas that position is the one in which they will be most strongly attracted. It would of course be otherwise were the rail reduced to a short piece of iron extending to comparatively a little distance from A. These observations apply equally well *mutatis mutandis* to the quadrants in which the magnetic power is repulsive.

With respect to the curious anomaly in the use of the thermometer referred to by your correspondent, "A. H.," I would suggest that a simple and immediate solution may be found for it without having reference to the *vis inertiæ* which he alludes to; when heat is applied to a thermometer the glass is expanded, and thus for an instant the mercury will *sink*, until the heat (which is not readily conducted by glass) expands the mercury also;—similarly the first instantaneous effect of cold will be to raise the mercury by contracting the volume of the bulb.—I am, Sir, &c.,

JOHN MACGREGOR.

24, Lincoln's-inn Fields, Feb. 21, 1848.

THE "NEW ANALOGY BETWEEN HEAT AND ELECTRICITY."

Sir,—Many years since, when making some experiments with thermometers, I observed the fact stated by "A. H." under the above title, (at p. 179,) viz., that on plunging a thermometer at 60° into freezing water, there is a sudden and momentary *rise* of the mercury before it begins to fall: and the reverse on plunging it into boiling water.

I accounted for it in this way; in the first case, the glass of the bulb contracts *before* the mercury inside is affected, a part of it is therefore suddenly forced up the tube, the amount of protrusion being in proportion to the difference between the thermometer and the temperature of the water. In the second case, the glass of the bulb is suddenly expanded before the mercury is affected, and a sudden fall is the consequence. I believe I am correct as to the cause.

This reminds me of another discovery I made from reasoning on the above. There is no difficulty in *at once* making a *boiled* egg spin round, because motion is communicated to the whole mass at once; but an *unboiled* egg cannot be made to spin until after many *continuous* efforts, because motion is only given to *the shell* without being communicated to the liquid mass inside.

R. S. N.

February 19, 1848.

LOGARITHMIC TABLES.—THE ALLEGED APPROPRIATION BY MR. HEARN OF MR. WEDDLE'S METHOD.

Sir,—In my paper on the formation of anti-logarithms, inserted at pp. 156, &c., I stated, as an inference from certain circumstances there detailed, that Mr. Hearn had, without acknowledgment, *appropriated* Mr. Weddle's logarithmic method. I have since received a letter from Mr. Hearn complaining of my statement, and explaining how the circumstances on which that statement was founded arose. The details of his explanation are confirmed by an accompanying letter from a friend of his own. I could wish that these explanations had been communicated either to yourself or to the editors of the *Mathematician* for publication. As it is, your readers can only have my account of them:

Mr. Hearn there states, that "the paper of his which appeared in the *Mathematician* for March, 1847, had been written several months prior to that date, *and before* any paper on calculating logarithms, written by Mr. Weddle, had been published in the same periodical:" and that "the whole method was shown and explained by him to a friend *before* the appearance of Mr. Weddle's paper." Moreover, "as to his having seen any papers of mine, he begs to inform me, that not only was he entirely unacquainted with my papers, but even with my name until the date of his writing."

Mr. Hearn's friend says, "he distinctly recollects Mr. Hearn showing him his paper in the early part of September, 1845, and that he was much surprised in the following November to find that Mr. Weddle had treated the subject in a very similar manner." He "further recollects being present in the same month of November, 1845, when Mr. Hearn handed his paper to one of the editors of the *Mathematician*, giving him at the same time the necessary explanation;" and he refers me to the gentleman in question for the reason why "no notice was taken of the paper before its appearance in the number for March, 1847."

I have no right, and certainly no desire to impugn the testimony of either Mr. Hearn or his friend; and therefore as, although less explicit on some points than they might be, they establish the fact, that Mr. Hearn's paper was prepared before the *appearance* of Mr. Weddle's, I have no difficulty in admitting that the charge of his having appropriated one of his methods from the last named gentleman, is no longer tenable. Nay more, if it shall be thought that the circumstances detailed in page 156—none of which, be it remarked, are called in question by either Mr. Hearn or his friend—did not justify me in adducing against that gentleman the charge now abandoned, I shall willingly admit that I ought not to have brought it, and express my regret for having done so. If, on the other hand, it shall appear, on a fair review of those circumstances, that they did afford grounds sufficient for making the charges complained of, the blame, I apprehend, must then rest with those, whomsoever they may be, who had the power of controlling the circumstances in question, and failed to exercise it.

I am, Sir, yours, &c.,

P. Gray.

37, Baker-street, Lloyd-square,
February 22, 1848.

[Although not sorry to find that Mr. Hearn has been able to exculpate himself from the charge of misappropriation, we must add in justice to the journal through which it was made, that there is nothing in the circumstances stated, to show that the *Editor* was less justified in publishing than Mr. Gray was in making it. The rights and claims of authors can only be judged of by what the public have before them: no cognizance can possibly be taken of productions kept locked up in the writer's desk, or intrusted to the keeping of a friend. Mr. Hearn would have had better cause of complaint could he have shown that, besides being unaware of Weddle's method at the time he *wrote* his paper, he was also unaware of it at the time that paper was *published*: and that the moment he did become acquainted with it, and saw how identical it was with his own, he had published somewhere—in the *Mathematician*, for example—those explanatory facts which have been at this late period extorted from him by the spirited and very natural strictures of Mr. Gray; but of all this we see no evidence. Mr. Hearn would appear to have encouraged by his own silence the false impression at which (as we gather from Mr. Gray's letter) he is now indignant.—Ed. M. M.]

BOWRA'S COLOUR EXTRACTING APPARATUS.

[Patent dated August 19, 1847. Patentee Aimé Bowra, of Rathbone-place, dyer. Specification enrolled Feb. 19, 1848.]

The present patent is for "improvements in colouring matters;" but it consists, in fact, of an improved apparatus for extracting colouring matters, there being no improvement effected (or at least claimed) in the matters themselves.

The patentee employs a metallic steam-tight vessel of a globe-like form, which is supported by hollow trunions or axles, mounted in a suitable frame-work so as to admit of its being reversed and the spent matter discharged through an opening in the top. The outer end of one of the hollow axles is fitted with a stop-cock and connected to a steam-boiler, while the inner end is attached to a pipe which leads into the interior and lower part of the vessel, and there terminates in a flat coil, which is perforated with numerous small holes. The outer end of the other hollow axle is connected in a similar manner with a reservoir of water, and is also furnished with a stop-cock. Underneath the flat coil is a partition of fine wire cloth through which the extracted colour and water pass, and thence out through an opening in the bottom of the vessel (to which a pipe is attached by means of a union joint) into a suitable receptacle. The opening in the top of the vessel is furnished with a cover, by means of which it is made entirely steam tight; the cover is fitted with a steam escape-pipe and stop-cock. Gauge cocks are placed in convenient positions in the vessels.

When it is desired to extract the colouring matter from any substance (logwood, for instance,) the vessel is filled with it up to just above the hollow axles; the cover is then fastened on and water allowed to run in, sufficient to cover and soak the material, after which the supply is cut off, and steam, of a pressure of about 10 pounds to the inch, allowed to flow in through the other hollow axle, whereby the water is caused to boil. The steam escapes through the jet pipe in the cover; when it has boiled long enough, say about twenty minutes, the outflow of steam is prevented, and a communication is opened between the bottom of the vessel and the receptacle through and into which the colouring matter and water pass under pressure. The operation is repeated for the purpose of extracting, as much as possible, all the colouring matter originally contained in the substance. The pipe in the bottom of the vessel is then disconnected and the opening closed, the supply of water and steam shut off, the top cover removed, and the vessel reversed so that the spent matter may be thereby readily and easily discharged.

RENARD'S WOOD PRESERVING AND COLOURING PROCESS.

[Patent dated August 19, 1847. Patentee, François Augustus Rénard, of Paris, for improvements in preserving and colouring wood. Specification enrolled February 29, 1848.]

The patentee proposes to impregnate wood with preserving or colouring matter by causing the latter to pass in a liquid state through the fibres. To effect this the wood is placed horizontally on a frame; at one end of this frame there is a vessel having a tap in the bottom and an opening at top through which a rod is passed into the interior, to the lower end of which rod is attached a piece of wire gauze. From the side of this vessel, opposite to where the wood to be operated on is placed, there projects a short pipe, fitted at its extremity with a disc of metal having a hole in the centre, against which one end of the wood is made to press tightly by suitable contrivances, so as to prevent the passage of air between the surfaces of the disc and of the end of the piece of wood, into the interior of the vessel. Around the other end of the piece of wood is fastened a bag, made of any impermeable material, which is connected with a reservoir filled with the preserving or colouring liquid. The patentee then creates a vacuum in the vessel, whereby the pressure of the atmosphere, acting on the column of the preserving or colouring liquid, forces it through the fibres of the wood into the vessel and drives before it the sap and moisture.

The mode of creating the vacuum preferred by the patentee is the following:— He dips the wire cloth in an inflammable liquid, ignites and places it inside the vessel, taking care to close the top opening and to allow the air to escape by the tap. When a vacuum is thus created, which is indicated by a barometer connected to the vessel, the tap is closed and the passage of the liquid through the wood continues until the vacuum in the vessel is destroyed. The expressed moisture or preserving or colouring liquid which may be in the vessel is run off by means of the tap, and the operation repeated as often as may seem expedient.

SHARP'S IMPROVED NOCTUARY.

Sir,—Having seen in a recent number of your valuable Magazine a letter purporting to be from "An Old Clockmaker" in Birmingham, commenting in not very courteous terms on my new registering clock, I would

ask as a favour (I know from your sense of justice not in vain) a space in your Journal for the purpose of explaining (in all kindness) to your correspondent and those of his opinion, the difference between my invention and the old noctuary which is still in many parts in use.

Your correspondent, to whom I do feel much obliged for the opportunity he has given me of explaining the advantages of my invention, either did not read the description of its principle—being perhaps perfectly satisfied in his own mind that the old noctuary was perfect, and that if mine was good for anything, that it should be identical in construction—or, having read it, the description had not been sufficiently explicit to convey to his mind the action of the different parts. Whatever the cause may have been, I feel considerable confidence in being able to satisfy him now as to its distinctiveness and superiority; and I also feel assured that the man who for the sake of truth publishes his convictions, will also publicly admit his errors, if convinced of their fallacy.

And now, Sir, if your friend will refer to the extract he made from *Thompson*, he will perceive by the sentences I here put in italics where the distinction exists.

Thompson says:—"The tell-tale clock was invented to insure the presence and attention of sentinels and night watchmen. Forty-eight movable pins *project round the edge of the dial* (*quære the periphery*), *which, turning round* once in twelve hours, brings one of these pins under a *fixed hand* each quarter of an hour. This *fixed hand* indicates the time, while behind the hand is a lever push-piece, which, when pulled by a cord, pushes in the projecting pin," &c.

Now if he will examine my description, he will not discover *any revolving dial—any stationary hand*; neither will he find the pins projecting from the *edge* of the dial.

But instead of these, he will perceive an *ordinary eight-day clock, with an ordinary dial and hands*; and from the *surface* of the dial, *within the figures*, a number (not limited) of pins projecting, over which the hands freely pass. When extreme accuracy is *not* required for the registration, one circle of pins, acted upon by the *hour* hand, is sufficient, as I find that the time can be so registered to within two minutes and a half of the exact time of pulling the cord.

Now this is near enough for all ordinary purposes; but if greater accuracy should be required, the principle admits of having a circle of pins acted on by the minute hand, and another for the seconds, thereby giving by one action and movement the hour, minute, and second of any particular occurrence. So much for the capabilities of the apparatus.

I need not enter here into a detail of the mechanism employed to move the hands towards the dial for the purpose of pushing in the registering pin: any mechanic can at once see that the thing can be done, and it will be sufficient for me to mention that it is so arranged that it cannot possibly affect the *going* of the most delicate timepiece.

I would here wish particularly to draw attention to some extraordinary advantages which my apparatus possesses with respect to *non*-liability of derangement and falsification of registration.

I will first mention some of the defects of the present noctuaries. They are never made to register nearer than within a quarter of an hour, and this in such a way that if the watchman is too late five minutes or so beyond a certain hour in pulling the cord, the clock registers against him as being absent a quarter of an hour. The natural consequence of this is, (I speak from actual knowledge,) that the watchman is in constant attendance on the clock instead of taking his round of the premises. This unnecessary watching of the clock is not required with mine, as there is a registration whenever the connection is pulled, and that within two or three minutes of the actual time. A watchman may thus be continually moving about, and he could legitimately account for a few minutes' delay when he could not do so for an hour.

Another source of error in the old noctuary is this, that the watchman can have access to the machinery by means of false keys, and by this means cause the registration to be made in advance to a considerable extent. The clock motion can also be stopped altogether by the watchman holding down the fixed hand, sufficiently long to come in contact with the succeeding pin, and there could be no proof that the stoppage was not owing to a fault in the mechanism. In mine these defects are avoided, for if an attempt be made to open the clock-case the registrations that have been already made will be effaced, and cannot by any possibility be renewed again; neither could any other registration be made except through the medium of the hands at the proper time. Further: if any attempt be made to stop the clock by holding down the hand for any length of time it would prove of no effect, as the instant the hand was released it would spring to the hour it would have been at, had it not been stopped at all.

And lastly; should ever a time come when watchmen will be immaculate or unnecessary, my clock would still retain its value as a timekeeper; and no one, surely, who *now* requires the services of such a functionary would regret to pay a little extra for a clock

which would provide so effectual a guarantee for his faithful services.

I remain, Sir, yours very respectfully,

R. Sharp.

Dublin, Febuary 24, 1848.

PATENT LAW CASES.

Court of Common Pleas,

Feb. 21 and 22.

BEFORE CHIEF JUSTICE WILDE AND A SPECIAL JURY.

Pilbrow v. The Pilbrow Atmospheric Railway Company.

The present was an action brought by Mr. James Pilbrow, the inventor and patentee of the well-known system of atmospheric traction identified with his name, against the Company which was formed in 1825 to carry it into effect, in order to recover £14,000, being the balance owing of a sum of £15,000, which the directors had covenanted to pay the plaintiff for an exclusive license. The action was, however, only nominally against the company; for the real defendants were admitted to be the Earl of Essex, the representatives of the late Earl Besborough, and Mr. Lambert—all the other gentlemen who were directors or shareholders having somehow or other slipped out of the concern.

The contract to pay the money was admitted, but the defendants pleaded that they were relieved from fulfilment of it because the invention had proved a failure, and was utterly worthless; and on this plea issue was joined.

The nature of the invention need not be here described, as it has been repeatedly noticed in our pages, and must be familiar to our readers—(see *Mechanics' Magazine*, Nos. 1115 and 1202.) Several witnesses were called on the part of the plaintiff, who spoke most favourably of the invention, though not all with equal positiveness.

Mr. Francis Wishaw, C. E., thought Mr. Pilbrow's plan a great improvement on Messrs. Clegg and Samuda's; and that it was, in fact, all that was wanted to secure the ultimate triumph of the atmospheric system.

Mr. George Rennie, C. E., was apprehensive that the rack and pinions would not stand the wear and tear to which they would be subjected at high velocities, but had no doubt that, by substituting friction or adhesion rollers (as provided for by the plaintiff's specification,) similar to those adopted in H. M. S. *Dwarf* for transmitting the power of the engines to the screw-shaft, at the dockyard, Woolwich for working the large till hammers, and in other instances, the plan would answer perfectly.

Mr. Thorold, of Norwich, thought so well of the system, that he had offered to contract to lay down a line of railway upon it.

Mr. Robertson considered the invention when it was brought out to be quite new, and saw nothing mechanically impracticable in it (meaning as explained in the *Mech. Mag.*, No. 1115, p. 422, when adhesion rollers were used, and "neither cogged wheels nor racks,") and thought it was well deserving of a trial.

Mr. Newton had never had a good opinion of the atmospheric system, but thought that if anything could make it answer, it was the plan of Mr. Pilbrow.

For the defendants there were examined Mr. Heighton, telegraphic engineer to the London and North Western Railway, Mr. G. P. Bidder, Professor Cowper, Mr. Cottam, and Mr. John Farey, who all concurred in pronouncing the scheme to be utterly impracticable whether racks and pinions, or adhesion rollers, were used.

Mr Bidder had calculated that, to make the pinions revolve at the rate necessary to produce a velocity in the driving carriage of thirty miles an hour—to do less than which was doing nothing—would require a force of no less than 100 tons; and this without taking at all into account the weight of the following train. But it was impossible that any pinions could withstand such a force as that; they would be infallibly shivered to pieces. Then supposing adhesion rollers to be substituted, they would at least require a pressure upon them equal to that which is ordinarily used to cause the driving wheels of locomotives to take the requisite grip of the rails, which was from 10 to 12 tons; but how such a pressure was to be obtained on this plan he (Mr. Bidder) did not know, and there was no method of obtaining it pointed out in the plaintiff's specification.

An intelligent mechanic, of the name of *Gore*, was also examined, who stated that he had superintended the working of the models of the plaintiff's invention at the Company's offices and at the Adelaide Gallery, and that though they had never been subjected to a pressure of more than about 3 cwt., the teeth were constantly breaking when the rack and pinions were used, and the piston running away from the carriages when the friction rollers were substituted in consequence of the failure of the rollers to transmit to the carriages the requisite impelling power.

The Lord Chief Justice, in his charge to the Jury, laid it down that, if they were satisfied that the plaintiff, at the time he entered into the contract with the defendants, honestly and conscientiously believed that his invention was a practicable one, they were bound to find a verdict for him, no matter how the thing might have turned out afterwards; but that if they thought he must or ought to have known from the first that it was a scheme which could not answer, it was their duty to find for the defendants.

The Jury, after deliberating some time, gave a verdict for the defendants.

Counsel for the plaintiff—Mr. Serjeant Talfourd, Mr. Bramwell, and Mr. Robinson; for the defendants—Sir Frederick Thesiger, Mr. Bovill, and Mr. Peacock.

Court of Queen's Bench.

July 23 and 24.

BEFORE CHIEF JUSTICE DENMAN AND A SPECIAL JURY.

Lowe v. Penn.

This was a new trial of an action brought by the plaintiff against Mr. Penn, of Greenwich, for the infringement of the patent granted to the former for a screw propeller. At the former trial, which took place on the 16th December, 1844, and was fully reported in our Journal of the 21st December, 1844, a verdict was found for the plaintiff. The Court afterwards granted a new trial on the ground that the plaintiff's specification did not specify the precise number of threads or turns to be given to the propeller, and that this point, which was material, had not been sufficiently pressed on the attention of the Court and Jury. After a trial of two days' duration, the Jury again found a verdict for the plaintiff.

Counsel for the plaintiff—the Attorney General, Mr. Serjeant Byles, Mr. Webster, and Mr. M. Smith For the defendant—Sir Frederick Thesiger, Mr. Martin, and Mr. Peacock.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Edward Massey, of Middleton-square, Middlesex, watch-maker, for improvements in logs and sounding apparatus. February 18; six months.

Edward Duncombe Lines, of Chelsea, and Samuel

Levy Prestfeont, of Love-lane, gentlemen, for improvements in the manufacture of colours, oils, and varnishes, and in the manufacture of charcoal, and also in treating vegetable substances for and in obtaining extractive matters therefrom. February 18; six months.

William Irving, of Trigon-road, Kennington, engineer, for improved apparatus for cutting or carving ornamental forms in wood, stone, and other materials. February 23; six months.

James Nasmyth and Holbrook Gaskell, both of Manchester, engineers, for certain improvements in machinery or apparatus for forging, stamping, and cutting iron, and other substances. February 23; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Feb. 18	1362	Marius Pierre Philip Bourjeaurd	17, Deverall-street, Dover-road	Elastic surgical bandage.
"	1363	Robert Yeates	Upper Fountain-place, City-road	The acute cutter.
19	1364	Wellington Williams	34, Gutter-lane, Cheapside, manufacturer	Shirt collar.
"	1365	Thomas Lambert and Son	New Cut, Lambeth	Water-closet basin and trap.
21	1366	Meyer Isaac, Tobias and Co.	Liverpool	Independent compound seconds' movement.
22	1367	Henry Doulton	Lambeth Pottery, Lambeth	Air-tight jar and cover.
"	1368	William Williams and Samuel L. Taylor	Bedford Cotton End	Improved Chaff-cutter.
23	1369	George Chambers and Co.	Gresham-street	Pin and needle-box.
"	1370	Joseph Wright	Gough-street	Mechanical movement for carriage windows.

NOTICES TO CORRESPONDENTS.

"D."—Consult Robertson Buchanan's "Practical Essay's on Mill's Work," and Oliver Evans's "Young Millwright." The latter is an American publication, but may be procured through some of the American Booksellers in London.

"A Student."—Mechanics' Magazine, vol. 34 and 35 passim.

"Trebon" declined.

Communications received from W. P. F.—Hibernicus—A Miller—J. J.—Spurwheel—Mr. Cairns—A Reader from the First—Velox.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166 Fleet-street.

JONES' PATENT IMPROVEMENTS IN STEAM ENGINES.

Fig. 5.

Fig. 1.

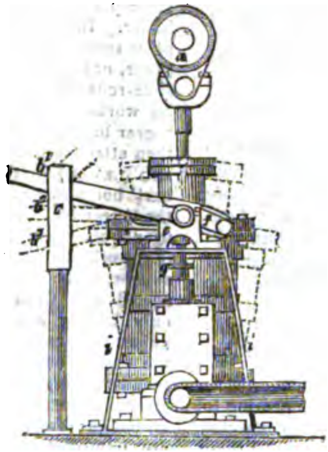


Fig. 4.

Fig. 3.

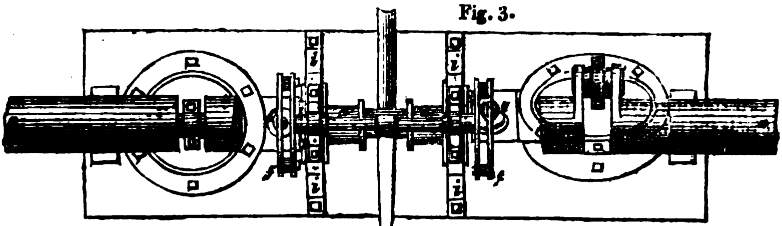
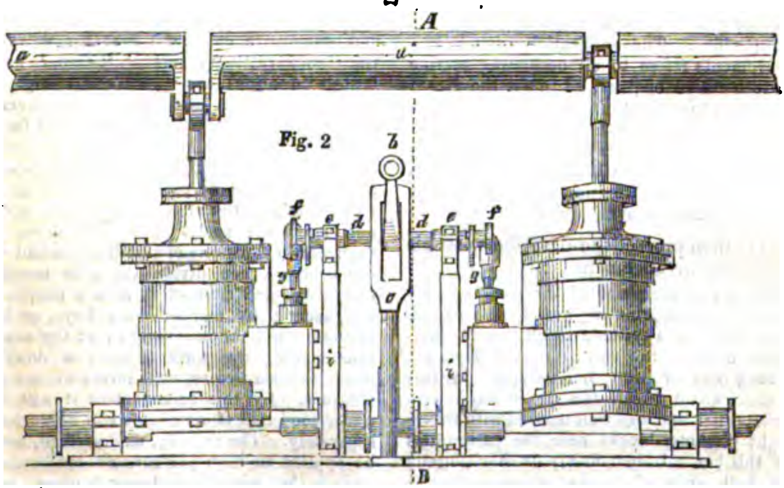


Fig. 2



MR. THOMAS STOFFORD JONES' PATENT IMPROVEMENTS IN STEAM ENGINES AND IN MACHINERY FOR PROPELLING VESSELS.

[Patent dated January 14, 1847. Specification enrolled January 14, 1848.]

The "improvements" embraced by this patent are six in number: some of these give fair promise of being highly useful; others belong rather to the category of barren speculation; but all are well deserving of attention for the mechanical knowledge and ingenuity which they display.

I. The first improvement relates to oscillating engines, particularly when employed on board ship; "the working gear of which," says Mr. Jones, "I reduce and simplify; whereby a plain and simple action and more ready means of working the engines are effected, the expense of construction is lessened, and friction is greatly reduced." In explanation of this branch of his invention, Mr. Jones observes:

There exist various modes of gearing to work marine engines, whether connected with fixed or oscillating cylinders. All these modes of gearing are so well known that it is not requisite to describe their construction or application, but generally the working gear of oscillating marine engines consists of two starting levers, two eccentrics-eccentric rods and levers, besides other connections. All this gearing is in action when the engines are at work, causing great complexity, friction, and liability to disarrangement. Now, I propose to abandon most of the working gear above stated, and instead thereof to substitute my improvements herein specified. The application of my improvements refers to all oscillating marine or locomotive engines. I prefer the steam cylinders to oscillate from the base; I also prefer that the slide-boxes be fixed on the sides of the cylinders over the inside gudgeons and bearings; I do not interfere with the well-known formation of the steam cylinder, steam passages, and slide-boxes.

He then proceeds to describe what his improved arrangement is:

In my arrangement of the working gear in oscillating marine engines, I raise a small iron frame of a suitable height on the bedplate between the two cylinders; I place a strong bar of iron horizontally on this frame (which I call the GEAR BAR) with substantial bearings well secured with strong tight plummer-blocks near the extremities of this bar. I then firmly fix horizontally on both ends of the bar strong guides or sweeps of metal, of a length to be ascertained by the length of stroke, and of a curve corresponding with the motion of the cylinder. In the metal guides or sweeps I place securely the friction rollers, or metal slides, or blocks, attached to the head of the slide-rods, by which the slide-valves are to be worked. Having thus connected the "gear bar" guides, or sweeps and slides, I then attach a lever (which I call the WORKING LEVER) to the middle of the "gear bar" horizontally, and at right angles with the "gear bar," and of any desirable length to acquire power over the slides. As the working lever, gear bar, guides or sweeps, and slide rods, are all firmly connected and fixed together, the slide rods only having a to and fro motion in the guides or sweeps, and corresponding with the oscillation of the cylinders, it will be readily understood that when the working lever is elevated the guides or sweeps assume an oblique direction, consequently the valves are immediately moved, and the engines work upon the forward motion. When the working lever and sweeps or guides are again placed horizontally, then the steam ports are closed against the steam, and the engines stop. Again; when the working lever is lowered, the guides or sweeps take an opposite oblique direction, the valves open the steam ports, and the reverse motion is obtained; and when the lever is lowered or raised between any intermediate points, the "ease" motion will be effected: thus the working lever having a perfect and immediate command over the valves, the "forward," "reverse," "ease," and "stop" motions are under the complete and instantaneous control of the engineer. The correct adjustment of the valves is facilitated, regulated, and most truly ensured by this arrangement. When the engines are at work, there is no part of the gearing in motion except the slides and rods to open and close the ports. Should I deem it requisite to work one engine independent of the other, I can divide the gear bar in the centre and connect it with a coupling box, secured by one or more keys, or by any other well-known means; at the same time making the working lever a double lever, to form two separate levers or one at pleasure. By this arrangement it will be understood that either engine can be worked separately. The gearing, as described, may be applied to high-pressure or condensing engines, but when a condenser is placed be-

tween the two cylinders, a bracket may be fixed on each side of the condenser to receive the gear bar and working gear, as already set forth, instead of the frame raised upon the bed-plate as before stated. The guides or sweeps, as described, may also be applied to work the valves of locomotives with oscillating cylinders. As the engines are readily worked with one lever, as described, a connection may be made thereto, extending upwards to the deck, and by a wheel-lever, or other means, the engines may be easily worked on deck, and with perfect safety.

Fig. 1, of the accompanying engravings is a longitudinal section of an oscillating engine of the preceding description fitted to a steam-boat, taken on the line A, B, of fig. 2, which is a transverse section of the same; and fig. 3, is a plan of the machinery: *a*, is the shaft; *b*, the working lever, and *c*, index to the same; *d*, the gear bar; *e e*, the plummer blocks and gearings to the gear bar; *f f*, the guides or sweeps to work the slide valves; *g g*, the slide rods; and *i*, the upright framing, raised on the bed-plate to receive the gear bar. A separate view of part of the working gear is given in fig. 4.

II. Mr. Jones's next improvement consists of a peculiar arrangement for working the valves which open and close the ports, whereby he gives "*a lead* to the eduction port, so as to destroy quickly the elasticity of the steam by opening an early freedom for the waste steam to escape through the exhaust passage." It is represented in fig. 5 (a half view) and thus explained:

Fig. 7.

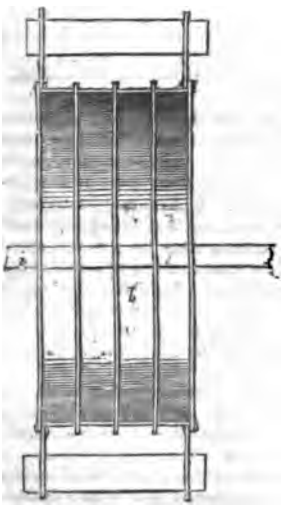
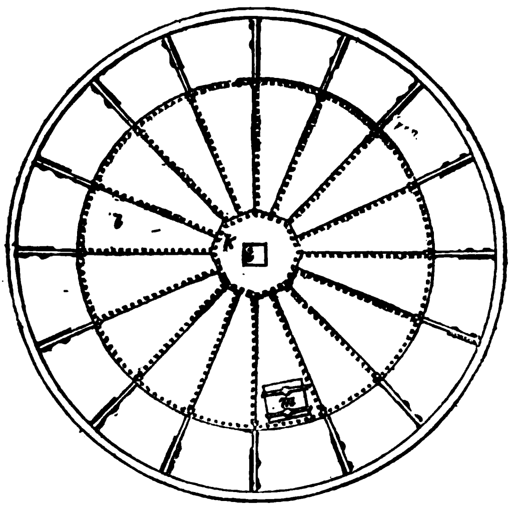


Fig. 6.



I do not interfere with the usual and general construction of the slide-boxes, valves, and steam ports; however, I prefer long steam ports, to admit the steam suddenly, and to limit the action of the valve. To obtain my object to give an early "lead" to the eduction port, I so make the concavity in the valve that when the piston is at either extremity of the cylinder, the main crank being then vertical, and when the engines are quiescent, the steam ports are closed against the inlet of steam; but I make *both ports* open on the eduction sides about five-sixteenths of an inch, more or less, into the cavity of the valve (as at *c*), and consequently leading into the main exhaust passage (*b*). On both the steam sides of the valves I would have an overlap of three-eighths of an inch (as at *d*), or a little less, if preferred. Now it will be distinctly understood that when the valves are acted upon by raising or lowering the working lever, the eduction port will continue to open into the exhaust passage, having already a lead of

five-sixteenths of an inch before the piston has arrived at the end of the cylinder (or before the main shaft becomes vertical); and when the *steam port* begins to open (which will be immediately after the main shaft-crank is vertical), the eduction passage will already have been closed against the steam port. When the main shaft-crank is quite horizontal, of course both ports are fully open—one as the induction or steam port, the other as the eduction port leading to the exhaust passage; but when the main shaft-crank approaches a vertical position, the valves alternate in their duty, and the new eduction port begins to open, to allow the escape of the waste steam; so that when the main shaft crank passes its vertical position, the steam, through the alternate or new steam port, must act with full force upon the piston. I am firmly convinced that the mode of regulating the valves thus described cannot be productive of evil when the main shaft-crank is vertical, or when the engines are stopped, in consequence of both steam ports being about five-sixteenths of an inch open to the exhaust passage, because they are at that instant both closed against the inlet of steam. The early "lead" for the waste steam, in conjunction with the great simplicity of the gearing and the immense reduction of friction, must be productive of the most beneficial results.

Fig. 8.

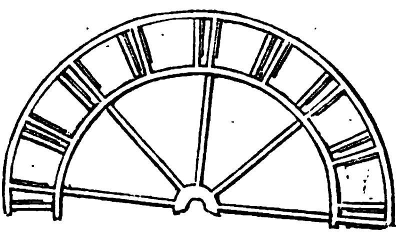
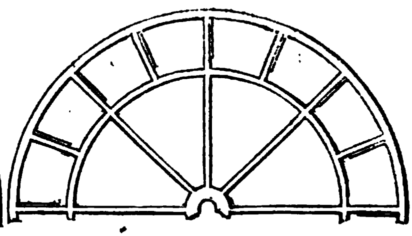


Fig. 9.



III. The third improvement specified consists in substituting hollow main shafts for solid ones. Mr. Jones, however, only proposes to do so "when desirable," with which qualification we may leave this part of the specification and pass on to

IV. An improved paddle-wheel, the advantages of which are thus set forth:

It is more or less admitted that the common paddle-wheel is destructive of power. The concussions of the floats on entering the water vibrate and shake the vessel throughout, and the floats, by their lift of water on leaving it, destroy power, and act as repellants. The object of my improvements for propelling is to reduce those evils, by adopting the following mode of constructing the wheel and adjusting the floats:—I divide the width of the wheel into three or more parts, but I prefer a division into four parts; and the more clearly to describe my plans, I call a section of my *wheel, one centre, with arms and circles, or rings united*, which may be combined, or made in any usual well-known and appropriate manner, and of lighter substance than in the ordinary wheel; the arms to receive the floats may be placed apart at any approved distance, but I prefer the distance of the floats to be *two feet six inches:* and in order to specify my improvements more clearly, I will suppose the dimensions of a wheel to be constructed to be twenty feet in diameter, and eight feet six inches in width, and the floats two feet six inches apart. I form five sections, each furnished with twenty-four arms or stays, to receive the floats. I place and fix the sections on the shaft, so that all the outward rings of the sections shall be two feet apart upon the three centre sections, extending from the inner ring to the outward ring; I place stays of iron seven and a half inches distant from each arm; the stays and the arms are to receive the floats in the manner afterwards described. Instead of paddle-wheel floats eight feet six inches in width, or divided into two parts across the width of the wheel (which has already been adopted, but without much or any good result), I prepare a number of floats two feet six inches in width, or thereabouts, and of any desirable depth of wood or iron, or of light corrugated iron, with or without stays at the back, in form either flat, concave, or convex; but I prefer corrugated iron to a flat surface for the paddle floats. I place on the first and second sections one of the floats of the dimensions already given; on the second and third sections I place another float, seven and a half inches distant from the first float: I then place a third float on the third and fourth sections, also seven and a half inches distant from the second float; I lastly place a fourth float on the fourth and fifth sections, also seven and a half inches distant from the third float. The floats being thus placed

in like manner, and at equal distances throughout the circumference of the wheel, it will be observed that there will be an overlap of the floats of four inches, or less; and when the wheel is in full motion, with the floats arranged, as described, I believe that the accumulated propelling power will be greater, than if the floats were of the entire width of the wheel, as the same column of water will be acting at right angles on the small floats, and the effect of the *lap* of the floats seven and a half inches apart will also give increased power; and as the repellant objections are so much diminished, it must be admitted that the floats, successively entering the water, seven and a half inches apart, with a lap of four inches, or less, throughout the circumference of the wheel, there can scarcely be any perceptible concussion of the floats on coming in contact with the water; the propelling power relative to the engines will be perfectly uniform and equable in the entire revolution of the wheel, and the great lift of back water will be reduced to a fraction. Therefore I consider that these improvements are conclusive proofs of the advantages set forth. Also I believe that a narrow wheel, with the modifications stated, will be a more effective propeller than a wheel one-fifth wider with undivided floats, or floats divided into two parts. Narrow floats are more readily reefed, removed, or replaced than wide floats. They may be made to extend one foot or more beyond the periphery of the wheel, and to recede one foot or more within it, thus reefing the wheel two feet or more. The mechanical construction of the wheel described will be stronger than the paddle-wheel in ordinary use, and need not be heavier.

Fig. 6, is a side elevation; and fig. 7, a vertical section of a wheel, on Mr. Jones' plan; fig. 8, is an outside view, and fig. 9, an inner view of a segment of the wheels, with the additional stays.

V. Mr. Jones proposes farther to make the centre of the paddle-wheel of a large water-tight hollow cylinder, or polygon, with a tube in the centre to be passed over the main shaft.

VI. And, lastly, he makes his floats of corrugated iron, to the employment of which for this purpose he lays exclusive claim.

CURIOUS CUSTOM IN HUNGARY, ILLUSTRATIVE OF CERTAIN EFFECTS OF HEAT, ETC.

Sir,—In reading "Kohl's Travels in Austria," &c., lately, I met with the following, (pp. 343, 344.) "The herdsmen of the Puste (or deserts in Hungary) practically carry out many scientific principles which with us are never used in common life. For instance, when they wish to keep anything cool they do so by the aid of fire, and in the following manner.—They dig a hole in the ground, into which they put the milk or whatever else they wish to cool; they leave a long narrow opening at the top, over which they light a fire; this fire draws away all the heat from the hole beneath and leaves it quite cold: they then quickly cover up the whole, and in this manner preserve their food fresh and cool."

There are so many circumstances on which this effect, namely, the preservation of the food "fresh and cool," may be dependent, that it would be almost impossible, without a great deal more information on the subject, to point out the real cause or causes.

We have something of the same kind, in so far as "Heat *versus* Heat" is concerned, in the well-known fact of the sun's rays "putting the fire out," or at any rate producing a very *deadening* effect. Philosophers at one time affected to disbelieve this phenomenon—but it requires only half an hour's observation to convince the most incredulous. A similar *deadening* effect is produced by burning a large quantity of paper or other materials on the *top* of a fire. There is also another very common custom (which I cannot say I have ever seen tried) of applying heat to a scald or burn "*to draw out* the heat," as the common phrase is.

It is a pity M. Kohl has not informed us *how long* the food will keep fresh, or whether the fire is required to be renewed, &c., &c. A. H.

THE "NEW ANALOGY BETWEEN HEAT AND ELECTRICITY."

Sir,—The explanation offered by your correspondent of the fact which I mentioned under the title of "A New Analogy between Heat and Electricity," is plausible, and such as no doubt has occurred to most of those who have observed the facts and attempted to account for them. But I have great doubts as to its correctness, for the following reason:—If any such appreciable time is taken up in transmitting the heat from

the glass to the mercury, a fracture of the glass would be the consequence. Such a process as the sensible contraction of the whole glass bulb must, I should think, take a longer time than the transmission of the heat from the glass to the mercury. In the absence of all positive evidence one way or the other, however, of course it must remain a matter of mere opinion as to which is the real explanation. Something would be done towards arriving at the truth, by having the bulb made of some other substance than glass, and observing the effect. If it takes any sensible time for the heat to be transmitted from the *exterior* to the *interior* of the glass—and if the contraction (or expansion) is *coincident* with this process—then the different *layers* or *strata* of the glass must be unequally contracted (or expanded), and a *fracture* is the necessary consequence. The only ground on which the explanation proposed by your correspondents is admissible is, that the transmission of heat from the exterior to the interior of the glass is instantaneous, but is suddenly checked at the surface of separation of the glass and mercury, thereby giving time for the contraction (or expansion) of the glass *before* the mercury is acted upon. Upon the whole, therefore, I consider the cause to which I attributed it by much the more probable one.

A. H.

SOLUTIONS OF THE CASE IN MENSURATION.

THE CASE (*ante* p. 60.)

"Giveth a circular shaped vessel; the top diameter being 225 inches, and the bottom diameter 150 inches, and the inside perpendicular height 275 inches. Required two vessels similarly shaped, the one to hold exactly an imperial pint, and the other an imperial half pint, both having their diameters and heights in the same proportion as the vessel given. The answer to be in inches, with proof."

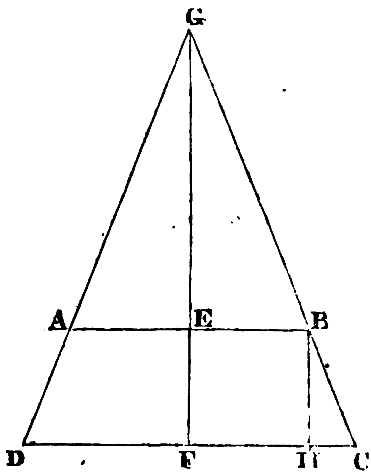
SOLUTIONS.

I. *By G.*

ABCD, is a vessel in the form of a frustum of a cone, of which DC, the greater diameter, $=a$, AB, the less diameter, $=b$, and EF, the depth, $=d$. It is required to determine s, the solid contents, in terms of a, b, and d.

Complete the cone by producing CB and DA till they meet in G, and draw BH parallel to EF. We have now two *similar* cones, GDC and GAB, the difference between whose solid contents will evidently be the contents of the frustum, ABCD, that is, the required value of s.

A cone being one-third of a cylinder, having the same base and altitude, the contents of the larger cone will be equal to the product of the area of the base of which DC is a diameter, by $\frac{1}{3}$GF. Now the area



of the base is, $DC^2 \times \frac{1}{4}\pi = \frac{1}{4}a^2\pi$, where $\pi = 3{\cdot}14159\ldots$; and we find GF from the similar triangles, GFC, BHC, thus:

$$CH : HB :: CF : FG;$$

or,

$$\tfrac{1}{2}(a-b) : d :: \tfrac{1}{2}a : \frac{ad}{a-b}.$$

Hence the solidity of the larger cone is

$$\tfrac{1}{4}a^2\pi \times \tfrac{1}{3}\frac{ad}{a-b} = \tfrac{1}{12}\frac{a^3d\pi}{a-b}.$$

Also, similar solid figures being to one another as the cubes of their homologous sides,

$$a^3 : b^3 :: \tfrac{1}{12}\frac{a^3d\pi}{a-b} : \tfrac{1}{12}\frac{b^3d\pi}{a-b} = \text{the solidity of the less cone.}$$

Hence

$$\tfrac{1}{12}\frac{a^3 d\pi}{a-b}-\tfrac{1}{12}\frac{b^3 d\pi}{a-b}=\tfrac{1}{12}\frac{(a^3-b^3)d\pi}{a-b}=\tfrac{1}{12}(a^2+ab+b^2)d\pi=s,$$

the solidity required.

From this expression, when any three of the quantities a, b, d, s, are given, the fourth may be readily determined. It is also applicable in other circumstances, one example being your correspondent's "case."

Here s is given, and the ratio of a, b, and d, as the numbers, say, m, n, p. Let, therefore, $a=mx$, $b=nx$, and $d=px$. We have then

$$\tfrac{1}{12}(m^2x^2+mnx^2+n^2x^2)\,px\pi=s,$$

or $$x^3\,(m^2+mn+n^2)\,p\pi=12\,s;$$

whence, $$x=\sqrt[3]{12\,s\div(m^2+mn+n^2)\,p\pi}\,;$$

or, in logarithms,

$$\log.\ x=\tfrac{1}{3}\,[\log.\ 12\,s-\log.\ (m^2+mn+n^2)\,p\pi].$$

The given ratios are,	225,	150	275,
or in lower terms,	9,	6,	11,
corresponding to	a,	b,	d.

Making then $m=9$, $n=6$, and $d=11$, the foregoing expression becomes,

$$\log.\ x=\tfrac{1}{3}\,[\log.\ 12\,s-\log.\ 1881\,\pi]\,;$$

which, when s = one pint = 34·65925 cubic inches, is farther reduced to

$$\log.\ x=\tfrac{1}{3}\,(\log.\ 415{\cdot}9110-\log.\ 1881\,\pi).$$

The valuation of this expression is easy, and need not be set down. It gives for x the value ·4128769. Whence

$a=\ 9x=3{\cdot}715892$ inches.
$b=\ 6x=2{\cdot}477261$ „
$d=11x=4{\cdot}541646$ „

and these are the dimensions of the vessel when its contents are to be one pint.

We can now easily find the dimensions of any *similar* vessel, whose contents are to those of the vessel whose dimensions have just been determined in a given ratio, the corresponding dimensions being to each other as the cube roots of the capacities. Thus, to find the dimensions of a vessel similar to the above, and of half its capacity, that is, to contain half a pint, we have,

$$\sqrt[3]{2}:\sqrt[3]{1}::3{\cdot}715892:3{\cdot}715892\times\frac{1}{\sqrt[3]{2}}$$

This gives the larger diameter, and the other dimensions are found in the same way from those given above, by multiplying these by the constant factor $1\div\sqrt[3]{2}$. The value of this factor is readily found by logarithms to be ·7937005; and this gives for the dimensions of a vessel similar to the above, and whose capacity is half a pint,

$a=2{\cdot}949305$ inches.
$b=1{\cdot}966204$ „
$d=3{\cdot}604707$ „

An interesting problem that may be solved by the aid of the preceding investigation is:—The top and bottom diameters and the depth of a conical vessel are given, equal to a, b, d, respectively, a being greater than b. Another vessel, of uniform thickness throughout, exactly fits into the first, the tops of the two being upon a level with each other. It is required to determine the thickness of the second vessel, when its capacity is to the capacity of the first in a given ratio, as 1 to r.

I beg to propose this problem for the consideration of your readers.

G.

Baker-street, Lloyd-square,
Feb. 8, 1848.

II.—*By Mr. C. C. Wharton.*

Your correspondent, "J—n M—s," of Battersea, in your Number of 15th instant, must mean a frustum of a cone.

$$\therefore \text{its contents}=275\ (225^2+225\times150+150^2)\ \tfrac{1}{12}\,\pi$$
$$=275\times106875\times{\cdot}26180 \text{ cubic inches.}$$

Then, if x be the depth of a similar vessel containing a pint, $=34{\cdot}65925$ cubic inches,

$$275\times106875\times{\cdot}26180 : 34{\cdot}65925 :: 275^3 : x^3$$

$$\therefore\ x^3=\frac{275^2\times34{\cdot}65925}{106875\times{\cdot}26180}\,;$$

whence, $x=4{\cdot}5416$ = the depth required.

In the same way the diameter of the lower end $=2{\cdot}4773$, and of the upper end $=3{\cdot}7159$.

The contents are $4{\cdot}5416\ (3{\cdot}7159^2+3{\cdot}7159\times2{\cdot}4773+2{\cdot}4773^2)\ {\cdot}26180$
$=34{\cdot}659$ cubic inches $=1$ pint, as required.

Again; if x be the diameter of the bottom of the smaller vessel,

$$x^3 : 2\cdot4773^3 :: 1 : 2$$

$$\therefore x^3 = \frac{2\cdot4773^3}{2}, \text{ or } x = 1\cdot9662.$$

In like manner, the height $= 3\cdot6047$, and the diameter of upper end $= 2\cdot9493$.

Brighton, Jan. 18, 1848.

III.—*By Mr. T. Wood.*

Assuming the form of the vessel to be a frustum of a cone, and cancelling each of the dimensions by 25, we have—depth 11 inches, top diameter 9, bottom 6.

$$\frac{11\,(6^2+9^2+15^2)}{264\cdot776} = 14\cdot208 \text{ pints},$$

the contents of a vessel whose dimensions are 11, 9, and 6 inches.

$$\text{Then } \overset{\text{pts.}}{14\cdot208} : \overset{\text{in.}}{11^3} :: \overset{\text{pt.}}{1} : 93\cdot679, \text{ whose cube root} = \left.\begin{array}{l} 4\cdot541 \text{ depth} \\ \tfrac{9}{11} = 3\cdot716 \text{ top diam.} \\ \tfrac{6}{11} = 2\cdot477 \text{ bottom do.} \end{array}\right\} \text{of pt. vessel.}$$

$$\text{Dividing each by } \sqrt[3]{2} \text{ we have } \left.\begin{array}{l} 3\cdot6042 \text{ depth} \\ 2\cdot9489 \text{ top diam.} \\ 1\cdot9659 \text{ bottom do.} \end{array}\right\} \text{of } \tfrac{1}{2} \text{ pt. vessel.}$$

By the slide rule:

Over 16·27 set 11 the depth; over 6 is 1·498
9 is 3·36
15 is 9·35

14·208 pints.

Under 14·208 pints on E set	11 inches;	under 1 is 4·58;	and under ·5 is	3·61
....	9	.... 3·71	....	2·95
....	6	.... 2·47	....	1·96

T. Wood.

London, Jan. 17, 1848.

Note by the Editor.

Of the three solutions above given, we prefer the first, because in it alone has due attention been paid to the *quæsita* of the problem, which are both solution and demonstration. Mr. Wharton's solution is, otherwise, very neat and very complete. He employs, it will be noticed, the same theorem as deduced by "G." for the contents of the frustum. Mr. Wood's first solution is, to us, less satisfactory, inasmuch as, although his values differ but little from those of "G." and Mr. Wharton, the formula he makes use of is by no means obvious. Had his solution been the only one received, we could not, solely from this cause, have given it to our readers without verification. His second solution by the slide rule is very satisfactory.

The preceding remarks will show what are our ideas with regard to modes of solution. A mere array of figures, however correct the result brought out at the close, is of comparatively little use. To be really beneficial, the reasons of the operations ought to be assigned.

We have also received a solution of the question from "Oseg;" but, in consequence of his omitting the factor $\frac{1}{3}$, his values would all require to be multiplied by the cube root of 4. Another solution by "J." (Tottenham), is wholly erroneous.

MATHEMATICAL PERIODICALS.

(Continued from page 155.)

V.—*The Gentlemans' Mathematical Companion.*

Art. XI. On the Communication of Motion by Impact and Gravity. By Dr. Milner: *Phil. Trans.*

XII. Observations on the Limits of Algebraical Equations, with a general demonstration of Descartes's rule for finding the number of Affirmative and Negative Roots. By. Dr. Milner: *Phil. Trans.*

XIII. An Investigation of the Principles of Progressive and Rotatory Motion. By the Rev. S. Vince: *Phil. Trans.*

XIV. A new Method of finding the

equal roots of an Equation by Division. By the Rev. John Hellins: *Phil. Trans.*

XV. On the Precession of the Equinoxes. By Dr. Matthew Young: *Trans. Irish Acad.*

XVI. On the Velocity with which Fluids issue from Apertures in the Vessels which contain them. By Dr. Matthew Young: *Trans. Irish Acad.*

XVII. A Synthetical Demonstration of the Rule for the Quadrature of Simple Curves, in the "*Analysis per Equationes terminorum numero infinitas.*" By Dr. Matthew Young. *Trans. Irish. Acad.*

XVIII. An Explanation of Fluxions, in a short essay on the theory. From a Tract published in 1741.

*** This paper is alluded to by Simpson, in the preface to his "Treatise on Fluxions;" and the principles and methods contained in it appear to have been used by Dr. Connell in his late work on the "Differential Calculus."

XIX. The Resolution of some General Problems in Mechanics and Physical Astronomy; viz.:

Prob. 1. Suppose a system of bodies, A, B, C (connected together), to revolve about a centre or axis (P), with a given angular velocity; it is proposed to find the momentum (k) which, acting at a given distance, QP, from the centre, shall be just sufficient to stop, or take away the whole motion of the system.

Prob. 2. Suppose that a plane, ABC, moving with a velocity and direction represented by bB, is acted on by a medium, or fluid, whose particles move with a velocity represented by DB, and in directions parallel thereto; to determine the effect of the fluid on the plane, in the direction of its motion, BH, and also what the angle of inclination, ABD, must be, that the effect may be the greatest possible.

Prob. 3. Suppose that a thread, ACn CA, having two equal weights A, A suspended at the ends thereof, is hung over two tacks, C, C, in the same horizontal line; and that to the middle point of the thread (n) equally distant from the tacks, another given weight, B, is fixed, which is permitted to descend by its own gravity, so as to cause the other two weights, at the same time, to ascend; it is proposed to find the law of the velocity by which the said weights ascend and descend; abstracting from the resistance of the air, the weight of the thread, and the friction on the tacks. By Thomas Simpson, Esq., F.R.S.: *Misc. Tracts.*

XX. Observations on the Theory of Walls, wherein some particulars are investigated which have not been considered by writers on Fortification. By Lieut. William Lambton.

XXI. Hints relating to the Use which may be made of the Tables of Natural and Logarithmic Sines, Tangents, &c., in the numerical resolution of Adfected Equations. By William Wales, F.R.S., Esq.: *Phil. Trans.*

XXII. Some properties of Geometrical Series explained in the solution of a Problem, which hath been thought indeterminate;—viz., "Given the sum (a), and the sum of the squares (b), of any geometrical series: to determine the series." By John Rotheram, M.D.: *Manch. Mem.*

XXIII. A Specimen of a New Method of comparing curvilineal Areas; by which many such areas may be compared as have not yet appeared to be comparable by any other method. By John Landen, Esq., F.R.S.: *Phil. Trans.*

XXIV. Some new Theorems for computing the Areas of certain Curve Lines. By John Landen, Esq., F.R.S.: *Phil Trans.*

XXV. A Method of Finding by the help of the Binomial Theorem, a New Value of the very slowly-converging infinite series:

$$x + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{4} + \frac{x^5}{5} + \&c.;$$

when x is very nearly equal to unity. By Francis Maseres, Esq., F.R,S.: *Phil. Trans.*

XXVI. A new and very useful Lemma, necessary in constructing Geometrical Questions, relating to the Maxima and Minima.

Proposition.—Let ABC be any triangle; the difference of any two sides AC, AB is less than the third side, BC. By Reuben Burrow, Esq.: *Bur. Diary.*

*** By means of the above, the author gives a neat solution to the problem: "Let DS be a given line, A and B, two given points; it is required to find a point P in the line DS, so that AP − PB shall be the greatest." For the case when the *sum* of the lines is a minimum, *see* Simpson's Geom. Max. et Min. prop. I.; or Potts's Euclid, p. 293. Both

cases are also elegantly solved by Leslie, in his Geom. Anal. B. 3, prop. 33, pp. 176, 7.

XXVII. A new Method of Resolving Cubic Equations. By James Ivory, Esq.: *Edin. Phil. Trans.*

*** In this paper the illustrious author shows that any cubic equation $x^3+Ax^2+Bx+C=0$ will have *three* real roots, or *one* real root, or *two* equal roots, according as $(4B^3+27C^2)-2AC(9B-A^2)+A^2(2AC-B^2)$ is negative, positive, or zero.

XXVIII. On the Catenary. By John Landen, Esq.. F.R.S.: *Land. Lucubra.*

T. W.

Burnley, Lancashire, Feb. 16, 1848.

(*To be continued.*)

SIR SAMUEL BENTHAM'S PLANS FOR SEASONING AND DRYING TIMBER.

Sir,—The due seasoning and means of preservation of timber having at length attracted the notice of men of science, perhaps an abstract of papers drawn up by the late Brigadier General Sir Samuel Bentham—who paid great attention to this important subject—may be thought worth insertion in your columns; as also the description of a timber seasoning-house designed by him.

In the year 1811, Sir Samuel was officially called upon to give his opinion on the means of prevention of the dry-rot in ships, and as to the most approved manner of storing and seasoning the frame timbers of them. He in consequence (March, 1812,) entered into a statement of the various means of seasoning timber which had been employed in this and other countries for the purpose, bringing to view the great difference experienced in the durability of timber in different instances, and the precautions and preparatory processes that had previously been employed for rendering it more durable. Although this letter was published in his "Naval Papers," yet as that work is out of print an abstract of its contents, it is hoped, will not be unacceptable:

The author begins by stating facts tending to elucidate the subject, noticing the great durability of timber in some cases; for instance, Westminster-hall and Abbey, old mansions, and other buildings on land. In the construction of ships he instances the *Royal William*, which had then lasted near a century; whilst on the other hand, timber of late years had been found to decay so rapidly, that in some cases wood-work in buildings on land, particularly where dry-rot had taken place, had dropped to pieces in a year or two; and in ships the same rapid decay had been found to take place in a like short period.

On investigation, it had not appeared in cases where timber had been of long duration, that it had been submitted to any preparation other than that of its having been cut down a length of time before it was used, sufficient for the natural moisture to be dried away. It was for this end that boards and timber in small scantlings were usually piled in such manner, as to let air pass between them; for though in this way the exterior pieces might be rent and injured by exposure to sun, wind, and rain, the more protected parts became what was called seasoned. In regard to large timber, when left with its sap on, in the course of some years, the interior had become hard, compact, and dry; but where the sap had been cut off, as in the case of *sided* timber, it had been more or less cracked or damaged before the inside became sufficiently seasoned.

Buildings of different constructions had been provided in His Majesty's dockyards, in which wood of all kinds had been deposited in various ways, more or less suited to the passage of air between the several pieces; the general result of which had been that in regard to wood of small scantling, so that the passage of air between the pieces had been facilitated, this mode appeared to have been advantageous; but for large scantlings, where the buildings had been closed, the timber within had been found to decay very rapidly; whilst where a free passage of air had been admitted, timber had been found to be more injured than when left in the open air; and this both in His Majesty's dockyards and in other countries.

In buildings on land, timber is often employed in situations where it can dry gradually after it is in its place: but in the construction of ships the case is very different; the most important parts of the timbers are so closed in, that unless previously well seasoned, these parts

have been found to decay very rapidly; even in those parts exposed to the air, as the exterior surfaces are often coated with some pigment, unless the timber has been previously well seasoned, they too are often found to decay very rapidly, notwithstanding their general exposure to the air. It is therefore essential to the durability of a ship that the wood which enters into its construction should be previously well seasoned.

The best mode hitherto in use for seasoning timber is thus shown in this paper to consist in leaving it long in its sap exposed to the open air. The General several times notices, however, as an objection to this mode, its *costliness*, arising principally from the loss of interest on the capital laid out upon the timber.

He then specifies various expedients which had been resorted to for the more hasty seasoning of timber,—such as in warm countries, covering it with sand, so that the heat of the sun might dry away the moisture *gradually;* covering timber with unslacked lime, to produce a *gradual* heat,—an experiment which had been made under him in Deptford Dockyard: whereby the timber was rendered very dry, compact, and hard, but it became by the too sudden application of heat cracked and rent, as in this mode it was difficult to regulate the degree of heat; besides which, it was costly. The surfaces of timber had also been *charred* for its preservation, as was said by old shipwrights to have been practised for the timbers of the *Royal William;* and as is commonly done for the preservation of the lower part of posts to be sunk in the ground, &c.; but according to the usual mode of performing this operation, the *sudden* application of heat cracked and rent the outer parts before the interior had time to dry. Under some circumstances, as in the instance of steaming planks in a *close* kiln, a heat even greater than that of boiling water may be applied without injury to the timber.

"It is, therefore," said, Sir Samuel "on the providing means of applying any degree of heat, even greater than that of boiling water, to the whole of the timber to be used in the construction of a ship—on the varying the degree of this heat suitably to the different kinds of timber to be seasoned, and to the different states and stages of its seasoning—on the regulating at pleasure the admission of dry air, and the emission of that charged with vapour, that my expectations are grounded in respect to the advantages to be derived from the use of the seasoning-houses proposed."

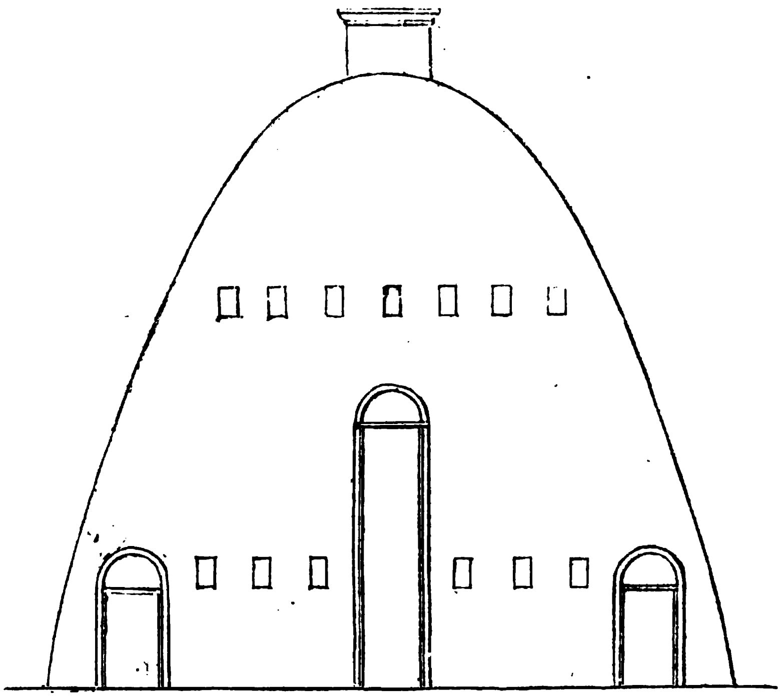
He then spoke of impregnating wood with *chemical* preparations, for the purpose of rendering it more durable, and stated that this subject was "well worth attention as the object of a series of well-grounded comparative experiments;" but that the experience already had upon the subject was not sufficient to justify the use of any substance that had been so applied otherwise than as matter of *experiment*. He brought to view, that long ago, the impregnating wood with metallic salts had been suggested,—sulphate of copper by Dr. Hales; sulphate of alumine by many, grounded on observation of the long duration of wood in alum-works; sulphate of lime; sulphate of iron, which he had known to arrest the progress of dry-rot. But the means of impregnating wood, either expeditiously or effectually, with such solutions, is both difficult and costly, excepting by previous exhaustion of the air from the wood, (as first specified in his patent, 1795,) with a view to the impregnation of timber. In America, wood had been impregnated with oil with good effect, as well for the preservation of the wood as for protecting it from the sea-worm; a fact which had been corroborated by experiments he had caused to be made, many years back, at Plymouth Dockyard. He had seen the vegetable and carbonic acids arising in the smoke of burning wood employed with great advantage, as in Russia, for many small articles, such as wheel-carriages and sledges: in parts of America, wheels are so seasoned; sabots, &c., in France. In 1805, he had so seasoned block-shells in Portsmouth Dock-yard, and tried the seasoning of them in steam. The series of experiments he had then commenced as to the means of preservation of timber, was put a stop to on his being sent on a mission to Russia.*

* An article in the *Quarterly Review* of September, 1812, on the subject of Covered Docks, and the Seasoning of Timber, bears, in most of its statements, so strong a resemblance to Sir Samuel's official letters on these subjects, adducing so many of the same facts and arguments—sometimes almost in his very words—that the author was believed to have had access to Sir Samuel's official documents, especially his letters of the preceding 6th and 9th March.

Since that time several chemical preparations have been recommended, and even patented, for the preservation of timber; but no such exhaustive series of experiments as he advised has ever been attempted, either as a public concern, or by any private person, although he had suggested this measure as early as Oct., 1797, and on several subsequent occasions: there remains, therefore, a wide field still open for investigation; so long as wood of any kind continues to enter largely into structures on land or on water, the ascertaining the most efficient and cheapest means of its preservation, cannot but be considered of immense interest to society at large.

Sir Samuel's design for a timber seasoning-house is represented in the accompanying sketches: fig. 1, being an external elevation; and fig. 2, a transverse section. His description runs as follows:

Fig. 1.



"The seasoning-house, according to this design, is calculated to contain the whole of the timber and plank that enters into the construction of a first-rate; viz., about three thousand loads. The building is designed to be entirely of brickwork, of a form which may be constructed with the smallest quantity of materials, and at the least expense; and which suits for the stowage of timber of different lengths with little loss of covered space. The walls are formed of two strata of brickwork, having a stratum of charcoal dust between them, to prevent the escape of heat; which charcoal dust may be obtained at a cheap rate by making it from the sawdust of the dock-yards. To protect the whole more completely from moisture, the exterior of the building is designed to be plastered with Roman

cement. The windows are few and small, being just what are necessary for giving light for stowing the timber: and they are double; so that as little heat as possible may be transmitted through them.

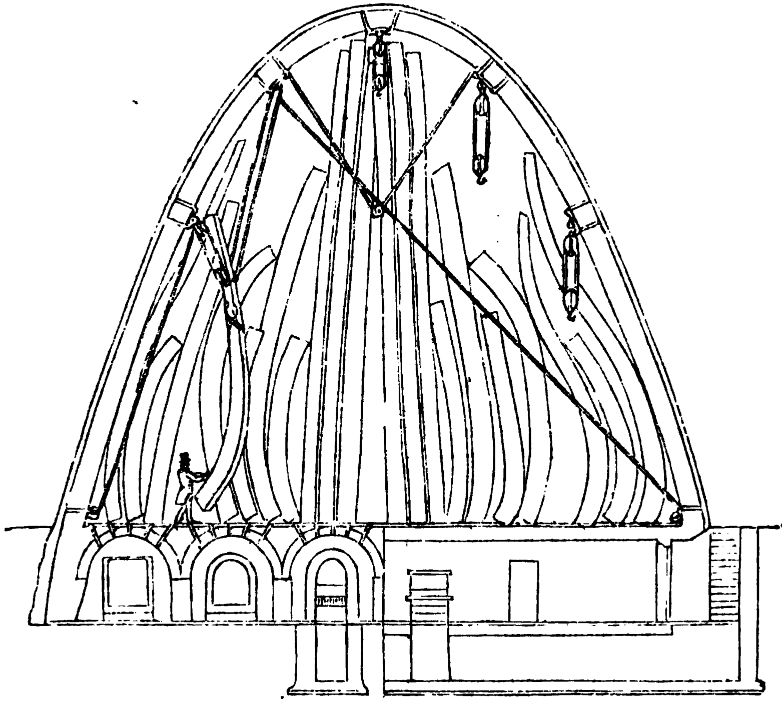
"The interior of the building consists of two parts:

"1st. The space *above* ground, which it is intended should be as closely as possible filled up with timber, placed as nearly upright as the different shapes and modes of support will admit of.

"2nd. Ranges of vaults underneath, in which are placed the fire-places, the flues, and the whole of the apparatus for regulating the heat.

"The passages to the fire-places, for conveying fuel, and for tending the fires, open from *without*-side the building, with a view to safety from fire, and to

Fig. 2.



the health and comfort of those employed in attending the houses. Parts of the flues are formed of cast-iron, in the form of shallow pans, which would serve for the application of steam, or for the slow combustion of sawdust, so as to produce smoke and acid; and by means of the same fire-places, apparatus might be heated for the production of any other vapour or gas with which it might be desirable that the timber should be impregnated. The fire-places are calculated to produce, when requisite, a degree of heat sufficient, after the timber should have been dried, to char the outside of the whole contents of the timber-house at once; and, by the perfect means afforded of excluding air, and of putting out the fires, the charring might be suddenly stopped when desired.

"For carrying off the moisture from among the timber, air is designed to be

admitted first into these vaults, where it would become heated to the requisite degree, and would then pass upwards into the timber-chamber, through the vacuities left in the vaulting for this purpose.

"Along the upper part of the timber-chamber means are provided for facilitating the hoisting up and placing of the timber. The force requisite for this purpose might, as it is but occasionally required, be most economically that of horses, unless in cases where a steam-engine, erected for other purposes, should happen to be near enough to have its force applied occasionally to this purpose also.

"The estimate for a seasoning-house of those dimensions, including all the apparatus above mentioned, amounts to the sum of £5,929 10*s*.

"To set against this expenditure, *over and above* the advantage of ensuring the most *perfect seasoning* of the timber, would be the saving of the interest of the capital lying dead during the seasoning of timber in the common way."

Sir Samuel then entered into detailed calculations, which exhibited that, allowing three years only for the seasoning of 3,000 loads of timber, the interest, compounded half-yearly on the capital lying dead, amounted to £7,186. But as in these seasoning-houses three months would be ample time for seasoning that quantity, the expense incurred in them, allowing 10 per cent. in the way of rent for the house, 250 chaldrons of coals, at 52*s*., together with interest on the timber whilst seasoning, would amount to £1,360 14*s*. 8*d*.; so that supposing the house to be charged only three times a year, the annual saving by its use would amount to no less a sum than £17,478. The capital sunk on the house would thus be refunded in less than half a year.

These calculations, it should be observed, were made on the war prices of the time. The abolition of Sir Samuel's office the same year prevented the execution of this, and many other of his plans of improvement.

It is evident that a seasoning-house of this nature might be made, and advantageously employed on a small scale for private purposes; yet the operation would be effected at a lesser rate of cost in a large establishment, and the dessication and other preparation of the wood, it may be supposed would be more perfectly attended to, where the quantity operated upon should be sufficient to afford adequate remuneration to a competent superintendent timber seasoner. It cannot but be wished that Messrs. Symington and Co. should reap from their dessicating process the advantages they so well deserve; but as Sir Samuel's paper was published about eighteen years ago, the subject is still open to those who may see reason to embark in an establishment for the dessication as well as the preservation of timber.

I am, Sir, yours, &c.,
M. S. B.

NOTES ON THE THEORY OF ALGEBRAIC EQUATIONS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[Resumed from vol. xlvi. p. 569.]

Second Series. Note A.

Some of the topics treated* of in the first series of these Notes admit of fur-

* While I am constrained to differ from an opinion expressed** in a recent editorial article, at the same time I feel bound to express my high estimation of the learning and ability displayed in it, and my deep sense of the advantages that cannot but accrue to the public from such searching and sagacious criticisms as those which pervade the article in question and others, on similar topics, which have appeared from time to time in this work. The opinion against which I crave permission to urge a few suggestions is that expressed with reference to the indeterminate process which occurs in (what is almost universally called) CARDAN's solution of a cubic. So far as the original solution of a cubic is concerned, it is indeed possible —perhaps probable—that the idea of substituting for the one unknown the sum of two unknowns presented itself to the mind of TARTAGLIA rather as an expedient†† than a principle. But, the discussion of a problem once brought to a successful termination by rendering the problem algebraically indeterminate, could this expedient fail to have its power tested in other cases, and if found available to take its proper place among scientific principles?—*Has* it failed in this respect? The answer may be in the negative without diminishing by one tittle the admiration due to the transcendent genius of DESCARTES which nowhere appears to greater advantage than in his treatment of an equation between two variables. In introducing two unknowns into a cubic, the object of TARTAGLIA was to obtain a finite expression for their sum or difference. His aim did not extend beyond this, and he would probably feel but little interest in any values of the unknowns other than those which would

** *Mech. Mag.*, vol. xlvii. pp. 592—593.

†† This is the view of MASERES. See a paper by him on the discovery of the solution of cubics in the *Philosophical Transactions* for 1780 (vol. lxx. pp. 221—238.) At the commencement of art. 2 (Ib. pp. 224—226) he conjectures that the substitution of the sum or difference of two unknowns was only one amongst a number of expedients that might have been tried. In the paper in question and another by the same author, published at pp. 903—949 of vol. lxviii. of the same *Transactions* (for 1778, part 2) the subject of cubic equations is treated at great length.

ther discussion. I shall first address myself to the subject of quadratic equations.

The ordinary solution of an adfected quadratic is obtained by reducing the given equation to the form of a pure quadratic, having of course roots different to those of the given one. In the solutions about to be noticed, the process is in effect the same.

At page 125 of vol. iv. s. ii. of the *Philosophical Magazine*, Mr. Joseph Seers has effected the solution of an adfected quadratic by means of a quadratic in d, d being the difference of the roots of the given equation. Let a be the coefficient of x in the last-mentioned equation, then

$$d = x_1 - x_2 = 2x_1 + a,$$

where x_1 and x_2 are the two values of x; but, another value of d will be

$$x_2 - x_1, \text{ or } 2x_2 + a,$$

hence the two values of d will be included in the expression

$$2x + a$$

and the roots of the pure quadratic in d which occurs in this solution are double of those of the pure quadratic employed in the ordinary method.

Both this method then, and the ordinary one, are in essentials the same, but the publication of the former elicited a letter from M. Fayolle, which will be found at page 314 of the volume just cited, and in which he gave the method of VARIGNON for the solution of quadratics.

The method of VARIGNON belongs to the class of indeterminate processes. It is as follows:

Supposing the quadratic to be given in z; we assume

$$z = x - y,$$

and obtain an equation which, compared with the given one, enables us to determine y, by means of a linear, and x by means of a pure quadratic equation. This pure quadratic is substantially the same as that arrived at in the ordinary method. The "type of solution" is identical in all.

At the close of his letter, M. Fayolle intimates that the method of VARIGNON is applicable to a cubic deprived of its second term. When so applied, however, it will be found that the difference of form between the solution so arrived at and that which we obtain by the ordinary method is but slight—even if there be any at all. In fact, the process involved in the latter solution is, substantially, that which VARIGNON has applied to the solution of adfected quadratics.

In a subsequent letter, published at 462—463 of the same volume,* M. Fayolle gave the process of LAPLACE for the solution of a cubic in which the second term is wanting. This does not differ materially from that given by NI-

enable him to arrive at such finite expression. The attention of TARTAGLIA was directed to isolated and particular values. But in the eye of DESCARTES, who invested two unknowns connected by an equation with the respective characters of abscissa and ordinate, every value was or might be of importance. In their perfectly distinct and independent developments, the views of TARTAGLIA and of DESCARTES diverge very widely—as widely as the geometrical element which enters into the latter might lead us to expect: and if the invention of the former analyst ended in itself so far as he was concerned, still, further applications and extensions of it could not fail to occur to his followers or successors. They would infer—and they have inferred—that if the principle availed in the solution of a cubic, it would also serve the purposes of science in other cases; and that, if certain results could be effected with two disposable quantities, then other, and more advanced though not more memorable, aims might be attained by the aid of a greater number of such arbitraries. Let us consider the case in which a third unknown or variable quantity is introduced into or appears in an equation. In the aspect under which the follower of DESCARTES regards this equation, we have before us the algebraic representation of a *surface*, in the discussion of which we follow the processes of analytical geometry, processes that have no place in the corresponding extension of the views of TARTAGLIA. We have a fine illustration of such extension of the last-mentioned views in a method employed by EULER for the solution of a biquadratic.** When more than three unknowns or variables appear in an equation, the difference between the spirit of the two systems becomes clearer; but the present is not a fitting place for further discussion†† of the subject. My object has been to rescue the process employed in CARDAN's solution from the charge of being an expedient barren for all purposes save that for which it was invented. Perhaps I am mistaken in supposing that such a charge was made in the article referred to in the commencement of this note; but in the importance which I attach to the correction of a (supposed) error contained in it, I trust that the writer will see a measure of the respect in which I hold his opinions.

** The solution of EULER is that given in the *Encyclopædia Metropolitana*, vol. i. pp. 616—617, (Pure Sciences —Article Algebra), where its analogy to the solution of a cubic previously (ib. p. 613) obtained is pointed out. In the solution of a cubic given in that work the process of VARIGNON for quadratics is followed.

†† This discussion would involve us in the consideration of Mr. Cayley's "Analytical Geometry of (*n*) Dimensions," Sir W. R. Hamilton's "Quaternions," Mr. Jerrard's Indeterminate Processes, my own "Method of Vanishing Groups," and other topics.

* *Phil. Mag.* second series, vol. iv.

CHOLSON, at pages 242—245 of a work* on Algebra with which his name is associated. It is easy to see that the principle of these two methods is one and the same, and a similar remark holds of their "types of solution," and these types do not present any features which are not to be found in those of the methods considered in the former series of these papers. Of course, I use the term *type of solution* in the same sense as in that series.

2, Church-yard-court, Temple, January 31, 1848.

Postscript. — ON THE CIRCLE. In my last paper on the circle (*supra*, p. 113) I have assumed that the diameter is equal to 10, but the result is not restricted in any degree by that assumption. If we had taken $2r$ as the diameter we should still have found

$$bH = 2\pi r,$$

the length of the circumference ABCD. The following correction must be made in that paper: *Sup.* p. 113, col. 2, line 14, *for* H*b* *read* A*b*.

CYLINDER BORING MACHINE.

[From a paper read by Mr. Beyer at the last meeting of the Institution of Civil Engineers, and reported in the *Railway Chronicle.*]

The desirableness of having all the cylinders of every class of locomotive engines perfectly alike, so that they may at any time be changed in case of accident, or be replaced by spare ones, it is presumed will be admitted by all; the difficulty of accomplishing this with the tools hitherto employed, will be known to most who are engaged in this branch of the business. These considerations, induced the author, in 1843, to direct his attention to the boring machine. The conditions which a good cylinder boring-machine should fulfil, may be stated as follows:—1. That it should make the cylinder perfectly round in its diameter, and parallel in the direction of its axis. 2. That the bored inside should be perfectly concentive or parallel with the outside of the barrel. 3. That the projections beyond the flanches, if there be any, should be true with the internal bore; and, 4. That every strain or pressure upon the barrel of the cylinder whilst boring should be avoided. The boring machine, hereafter to be described, has been found, during several years' practice, to have answered these conditions. Messrs. Sharp, Brothers, & Co., cast their cylinders from wood patterns in green sand, and commence the process of filling up by describing or gauging off a circle upon each end of the cylinder, concentric to the barrel, and having formed this circle the ends are bevelled inwards by chipping to an angle corresponding to that of the plates of the cone mandril. The cylinder being fastened to the mandril, is put into a two-foot slide lathe, with facing motion, and has its ends faced to a gauge, and its projections turned to a gauge, and cut to a length to gauge: there are further two notches cut out of two cone discs, so as to allow of applying an internal gauge for the out-and-out length of the cylinder. Thus prepared by turning, it is removed to the boring-machine, inserted between two plates, the faces of which are planed, and the holes for receiving them bored from the boring-bar in their places; it is at once perfectly concentive with setting, and needs nothing but clamping to the plates by headed bolts or clamps by its flanches to be ready for commencing boring. For placing the tops of the steam-chests and valve-facings, the turned ends are again made use of for setting, by placing upon the planing-machine table, brackets placed on their faces and bored out to the same gauge the cylinder is turned to, in order to insure the parallelism of these parts with the axis, as for similar reasons the inside of the cylinder could not be otherwise than concentive with the outside of the barrel. I prefer making a separate set of gauges, tackling, &c., for each size of cylinders rather than economize by making one do for many, and risk the chance of mistakes; and I believe that the plan here described, to work always from the same point, is most likely to insure accuracy, as the faults made by neglect of workmen are not multiplied by subsequent operations. The boring-machine bores by two cylinders at the same time, and is arranged to bore cylinders of 2′ 6″ strokes and from 10 to 20 inches diameter. The bed is that of a common slide lathe, sufficiently long to carry a double set of driving gear, and admits of a sufficient traverse of the boring-carriage. The boring-bar is supported by three bearings, the former of which is stationary and firmly fastened to the bed to resist the end and pressure of the cub when boring; the latter are fixed upon the carriage and travel with it along the boring-bar, and serve for securing the cylinder during boring; as will be shown hereafter. To cause the boring-carriage to move endways, a train of wheels descends at the back of the machine to give motion to the

* An "Algebra" by Peter Nicholson and J. Rowbotham, F.R.A.S., and of which the copy before me bears date 1837 on its title-page and preface.

shaft, and is transferred by means of a feathered worm to the worm-wheel and pinion, both of which move loose above the fast stud of the carriage. The same stud serves as a fulcrum for the lever, carrying upon opposite projections the intermediate pinions, which gear into the stud pinions. It will be obvious therefore, that by setting the lever in such a position as to bring one pinion into gear with another pinion fast on the rack-pinion shaft, motion will be given to the boring-carriage in one direction; and in an opposite or contrary direction by moving the lever so as to bring the pinions to gear with each other; and this carriage will be stationary or independent of the driving-gear altogether, by keeping the lever in its middle position. The rack-pinion shaft is extended towards the front of the machine to work the carriage by hand, when putting in or taking out the cylinder. A provision is also made in the train of wheels for varying the traverse of the carriage by changing the pinion. To hold the cylinder while boring, the top of the carriage is formed into a kind of square frame, by means of two plates, planed on the inside and fastened to the sides of the bearings or standards and two cross stretchers. The latter are also placed upon their inner faces and are secured to the sides and top of the boring-carriage, and have holes bored in them when secured in their places, by means of the boring head upon the bar corresponding in diameter to the turned projecting ends of the cylinder to be bored. It will be seen, therefore, that if the figure of the cylinder to be bored be turned to the same gauges as the holes are bored to, it need only inserting and clamping fast by the T bolts, to be ready for boring without requiring any setting whatever. One of the cross stretchers is a fixture, whilst the other is removed every time a new cylinder is to be fixed. The boring-head is a fixture upon the bar, and has only one plain square tire for boring, ground to cut either way: this tool fits into a planed recess made slightly dovetailed, and is held fast by a set screw, and easily adjustable to any diameter by another of these machines. We employ three of these machines—two double ones and a single one, and one man attends to these and the lathe for facing and turning the ends of the rough castings of the cylinders. The cylinders are cast as hard as we are able to cut them with the best cutting tools we can make, and we find it more advisable to complete the boring in three cuts; the first is often as much as three-quarters of an inch in depth, the second we leave about one-eighth of an inch, and the third can hardly be called cutting, but is merely clearing up or finishing. The advance, or traverse, we rarely change, and it is set to one-quarter of an inch for each revolution of the boring-bar; or for quickest speed of the bar, 3 revolutions per minute; in the second, 1·8 revolution per minute; in the third, or lowest speed, 1·2 revolution per minute. For boring, 15 in. cylinders—for roughing out, 1·8 revolution per minute, or cut at 7 feet per minute; for boring, 3 revolutions per minute, or cut at 11·78 feet per minute; and for finishing 1·2 revolutions per minute, or cut at 5·65 feet per minute.

GALVANIZATION METALS.—MESSRS. MOREWOOD AND ROGERS' LATEST IMPROVEMENTS.

In coating iron with molten zinc, the iron is very liable to injury, and the coating is generally brittle, and is apt to crack and break when being bended, and the coating will often chip or scale off. In coating iron with tin the malleability of the iron is retained, and the adhesion and flexibility of the coating is uninjured by bending or folding, but a coating of tin does not protect the iron as a coating of zinc does.

To obtain, therefore, the protection of zinc, combined with the advantages of tin, as a covering, and at the same time to obtain a harder coating than results from the use of either of those metals alone, Messrs. Morewood and Rogers now use an alloy of tin and zinc for coating iron. They have found that an alloy of tin with zinc, consisting of fifty parts of tin and fifty parts of zinc, is the best alloy of these metals which can be used as a coating for sheets of iron hoop, iron wire, and other articles of iron; and they have also found that if the proportion of zinc be much diminished, the coating becomes less durable and protective; on the other hand, they have found that if the proportion of tin be diminished, the adherence of the coating becomes less and less effective, and the iron proportionably injured.

The proportions of the two metals above given may, however, be varied to some extent, and yet considerable benefit obtained. It has been also found that lead may be combined with the alloy, when a cheaper or lower-priced coating is desired. In using an alloy of tin and zinc for coating iron, it is found that to alter the proportion beyond sixty-seven parts of zinc to thirty-three parts of tin, and seventy-five parts of tin to twenty-five parts of zinc, you are no longer able to obtain the beneficial results of the combined action of the two metals. Every departure from using equal proportions of the two metals seems to produce a decreasing

beneficial effect, and this in proportion to the greater departure from such alloy. In preparing an alloy of tin and zinc, they first melt the tin in a wrought iron vessel, and add the zinc by degrees, till the whole is melted; they then run the same into bars or ingots, and melt these ingots in a similar vessel of wrought iron, in order to make a bath for coating iron, and from time to time they put such ingots or bars into the bath of molten alloy, in order to keep up a proper bath for coating the sheets or other articles of iron, covering the surface of the molten metal with sal-ammoniac. The iron to be coated is to be cleaned in the ordinary manner, and then coated as when coating with tin or with zinc. When using lead with the above alloy, Messrs. M. and R. find that a good proportion for an alloy is fifty parts of zinc, thirty-five parts of tin, and fifteen parts of lead, and they produce such an alloy by melting the tin, then adding the lead, stirring them well, and finally adding the zinc.

It is further well known that in the process of coating iron with molten zinc a product of zinc results, which is precipitated to the bottom of the bath, and such product is of difficult fusion, and may up to this time be said to be a waste product. Now, Messrs. M. and R. melt such product of zinc in a wrought-iron vessel, or in a reverberatory furnace, and they employ chloride of magnese as a flux on the surface. They dip articles of iron, such as pikes, brackets, and other articles not requiring bending, into the bath, and coat the same. They also alloy such product of zinc, or other zinc, with antimony and with lead, when used for coating iron; for this purpose an alloy, consisting of 50 parts of zinc, 34 parts of lead, and 16 parts of antimony, is found to be very useful. And in preparing such an alloy they first melt the lead heated to redness before introducing the antimony, and when well stirred they cast the same into ingots, and after re-melting, they add the zinc, and, as a flux, they add chloride of manganese, if the product of zinc before mentioned be used in making the alloy, or if other zinc be used in making the alloy, they use sal-ammoniac.

A third improvement consists in subjecting sheets of coated metal to pressure; for which purpose Messrs. M. and R. prefer to employ rollers, revolving in a flux kept heated to a rather lower degree of heat than the melting point of the coating metal, by which means the coating is rendered soft, and in a condition to be acted on by pressure. They prefer to use palm or rape oil in all cases where the melting point of the coating is sufficiently low to allow of its use, as in the case of the coatings above mentioned. Or other means may be resorted to for softening the coating metal, such as a charcoal fire. When using a fire, it may be done by placing a grate containing charcoal along the front of the rollers, so that as they revolve they may become heated, and the metal by passing over the fire may become softened, and thus enable the rollers to equalize the coating metal on the surfaces of the sheets. Or, the sheets may be heated by dipping into flux, or otherwise, to nearly the melting point of the coating metal, and then pressing between suitable surfaces. The patentees, however, prefer the use of a flux or fluid matter with rollers for this purpose, as above explained.

A fourth improvement consists in facilitating the coating of such iron, by causing the iron to be acted upon by the vapour of muriatic acid (or of such other matter as will prevent or dissolve oxide) confined above the metal bath. For this purpose they construct a box, in the following manner: The box is oblong, of wrought iron, open at the bottom, and with a lid at the top; the bottom is closed by the lower edges dipping into the molten metal. On one side, about three-quarters of the way up, they make a longitudinal aperture sufficiently large to allow the article which they intend to coat to pass into, and when required, out of the box, but as it is desirable to exclude the atmospheric air, and keep in the muriatic vapour as much as possible, the aperture should be no larger than necessary. The object of having a lid on the top is to enable them by opening it, to have access to the flux or the molten metal in the bath, and from time to time to clean off impurities, or to add metal or flux. Into one end of the box they fix a tube made of lead or other suitable material, through which they introduce the vapour which is evaporated from a solution of muriatic acid contained in a retort. And for this purpose they prefer to apply this part of their invention when using rollers immersed in the metal bath, as the sheets to be coated can readily be passed through the opening above mentioned, so as to enter between the rollers, and the sheets will be delivered from the bath of molten metal through the flux therein, beyond the box above described.

METROPOLITAN SEWAGE MANURE COMPANY.

Sir,—Making brief reference to your remarks on "Sanatary Reform" at page 146, I beg to observe, that so far from the New Metropolitan Commissioners of Sewers having it in contemplation "to consult only the

public health, regardless of collateral benefits," they are, as you rather surmise, anxious to turn the sewage by all possible means to a beneficial use; and, instead of befouling the Thames by "consigning thither the refuse filth," they are quite alive to the immense advantages which agriculture and horticulture will derive from its distribution. I am surprised that no notice is taken of the *Metropolitan Sewage Manure Company*, which, by two Acts—10th and 11th of Vict.—has the sewage of the Westminster district granted to it, for the express purpose of conveying it into the country in a liquid form, in the same way as water is now conveyed, and who are proceeding with their works for this purpose under the sanction of the said commissioners, and according to the plans of Mr. Mylne, the eminent engineer of the New River Water-works, who reckons on being able to supply the neighbourhood of Fulham in the course of the present summer. It has been found by experience that sewage manure on lands or gardens gives out much less smell, and is much less offensive than solid manure, it being diluted by surface and cleansing waters. I am, Sir, yours, &c.,

C.

March 1, 1848.

Steam, the "all-powerful" agent of modern times is so new a thing as a mechanical power, that the very word was unknown to the English language in the days of our best standard English writers. It is not once used by Shakspeare, nor by the translators of the Bible. What we now call steam, was of old generally referred to as air, or wind, or smoke. Thus Job, in describing the leviathan, says, according to our English version—"Out of his nostrils goeth smoke (steam), as out of a seething pot or cauldron." And Porta, in his account of one of the earliest approximations to the modern steam engine, says—"As long as the water shall smoke, '*sfumera*,' the air will press the water," &c.

EPHEMERIDES OF THE COMING COMET.—BY JOHN T. BARBER, ESQ., OF TRINITY COLLEGE, CAMBRIDGE.

(Continued from page 188.)

Sir,—I now transmit to you ephemerides of the expected comet of 1264 and 1556, (continued from page 188, No. 1280,) extending to June 7, upon six additional hypotheses. As the comet may at this present time be visible, even supposing the perihelion passage delayed till the commencement of June, the results of the calculations may be of interest to those persons who are disposed to search for this body.

The aphelion point is distant more than 8,000,000,000 miles from the sun, which is greater than twice the distance of Neptune, whilst the orbit is very nearly seven times longer than it is broad; the nodes are situated very close to the earth's path, the ascending node being *without*, and the descending node *within* the orbit of the earth. The distance of the former is about 0·1919, and the latter 0·1349 from our path. The transit through the ascending node takes place 48·8 days before the passage through the perihelion; the descending node is passed about 29 days *after*. The periodic time of the comet will be considerably affected when the perihelion passage takes place near May 4 or August 23, owing to the near proximity of the nodes to the earth's orbit; thus, in 1556, the comet passed its perihelion on April 22 (O. S.), and on March 3, the distance between the centres of the two bodies was only 0·07298. The perturbation in the periodic time produced by this near approach to the earth, has been determined by Professor Mädler to be 14·5 days, and he therefore fixed upon the beginning of March, 1848, for its reappearance; but in such an enormous orbit, and where the body recedes to so vast a distance from the sun, it is impossible to say what causes may retard its reappearance.

The assumed times of perihelion passage are:

6	April 18, 1848
7	April 28, ——
8	May 8, ——
9	May 18, ——
10	May 28, ——
11	June 7, ——

The places given in the ephemeris are for Greenwich mean noon, of each day:

Hyp. VI.	Right Ascension.			Declination.				Log. Δ.
Date.	h.	m.	s.		°	′	″	
March 9	17	32	45	−	11	19	37	9·4696514
—— 19	20	21	52	+	5	0	26	·5237343
—— 29	22	3	12		13	4	3	·7044940
April 8	23	2	56		15	8	5	·8681163
—— 18	23	52	16	+	14	51	8	9·9982598
Hyp. VII.								
March 9	14	13	17	−	16	49	25	9·4266366
—— 19	17	35	47	+	4	30	54	·1172147
—— 29	21	53	30		24	18	24	·3748617
April 8	23	9	56		24	15	57	·6441875
—— 18	23	48	43		22	14	7	·8295004
—— 28	0	26	6	+	19	38	13	9·8685617
Hyp. VIII.								
March 9	11	58	42	−	14	40	6	9·5817003
—— 19	11	42	10	−	2	41	51	9·2847606
—— 29	8	37	29	+	65	24	46	8·9374707
April 8	1	1	52		47	23	1	9·3485930
—— 18	0	40	10		36	22	55	·6141532
—— 28	0	43	4		29	59	19	·7964920
May 8	1	3	34	+	24	46	50	9·9372127
Hyp. IX.								
March 9	10	56	41	−	12	18	58	9·7345941
—— 19	10	21	46	−	4	12	21	·5848044
—— 29	9	17	3	+	12	38	44	·4332146
April 8	7	14	34		37	12	29	·3809431
—— 18	4	27	3		48	25	26	·4821717
—— 28	2	34	2		44	58	42	·6296140
May 8	1	49	42		37	38	2	·7740981
—— 18	1	46	16	+	30	11	4	9·9052815
Hyp. X.								
March 9	10	23	56	−	10	53	48	9·8523016
—— 19	9	53	23	−	4	43	28	·7612904
—— 29	9	13	49	+	4	47	3	·6809863
April 8	8	25	2		17	17	53	·6271026
—— 18	7	25	20		30	43	53	·6100626
—— 28	6	9	0		41	51	28	·6295229
May 8	4	34	27		46	54	59	·6822521
—— 18	3	11	3		43	46	33	·7669180
—— 28	2	36	34	+	35	36	59	9·8744529
Hyp. XI.								
March 9	10	3	35	−	10	0	35	9·9444643
—— 19	9	37	45	−	4	59	23	·8821648
—— 29	9	9	21	+	1	45	52	·8315398
April 8	8	40	21		9	50	8	·7954087
—— 18	8	11	52		18	35	24	·7725610
—— 28	7	42	15		27	35	38	·7582911
May 8	7	5	28		36	33	53	·7493079
—— 18......	6	8	16		44	23	47	·7494522
—— 28......	4	43	15		46	52	22	·7766527
June 7......	2	22	48	+	50	1	31	9·7759713

JOHN T. BARBER.

Trinity College, Cambridge, February 25.

INQUIRIES AND ANSWERS TO INQUIRIES.

Chemical Matches.—"P. A. P." The wood for the best of these matches is cut by a machine patented by Mr. A. Meyer, December 4, 1839. At the City Saw-mills of Messrs. Esdailes and Margrave there are two of these machines in constant work, which produce no less than 3,296,000 splints per day. So vast, however, is the demand for these articles, that by far the greater portion are said to be made from hand-cut splints and from splints imported from abroad.

The Rolling of Lead into Sheets was invented by Thomas Hale, in 1670; and the first mill for the purpose was erected at Deptford. In the *Phil. Trans.* for 1674, the invention is ascribed to Sir Philip Howard and Major Watson, but these gentlemen were merely partners with Hale in the patent.

Perkins' Ship-pump.—"Nautilus." A description of this pump will be found in the 38th vol. of the *Trans. of the Society of Arts*, who awarded Mr. Perkins their gold medal for the invention.

Liquid Carbonic Acid.—"B. P." The force exerted by this acid at the low temperature of 32° has been estimated to be equal to 35 atmospheres.

Displacement of Ships.—"A Mechanic." It is impossible, in the space which we can here afford, to furnish the desired information, and there is no cheap book on the subject to which we can refer. We shall shortly, however, have occasion to notice a work on the "Theory and Practice of Ship-building," which has just come out, by Mr. White, the eminent shipbuilder of Cowes, and we may, then, perhaps, be able to extract from it an answer to our correspondent's inquiries.

Metal for Gudgeons.—"A Miller." Cast iron is inferior in cohesive force to wrought iron, but it possesses a valuable property which the other does not possess, viz., that of not being acted on by the grease or oil employed for lubrication, and for that reason it is preferred by many experienced engineers. It lasts, besides, a very long time: Buchanan makes mention of a water-wheel at Deanstown, near Donn, which had run for nearly thirty years on pillows or bearings of cast iron, with but little injury to the latter.

Bay-Leaf Teeth.—"J. J." The term "bay leaf," made use of by a juryman on a late trial, and "which nobody else seemed to understand," is commonly given in Lancashire to a form of tooth much in vogue there for watch-wheels, from its general resemblance to the bay leaf. It is of the character of the epicycloid, but is in practice, we believe, formed entirely by the eye of the workman; a practice which at the best can only be productive of an approximative accuracy.

NOTES AND NOTICES.

Magnificent Water-ram.—M. Fischer, of Schaffhausen, constructed a water-ram in the form of a beautiful ancient altar, nearly in the style of that of Esculapius, as represented in several old engravings. A basin about six inches in depth and about twenty in diameter received the water which formed the motive column. The water flowed through pipes three inches in diameter, which descended in a spiral form to the base of the altar; on the valve opening, a third of the water escaped, and the rest was forced up to a castle several hundred feet above the level of the Rhine.

Jones' Friction Hammer.—We have been favoured with a sight of a novel machine which has just been completed, and is now at work at the Great Western Works, the invention of Mr. John Jones, manager of the works, who also invented the "Cambrian Engine." The machine is called a "Friction Hammer," and consists of frames of cast iron in which are vertical slides acting as guides to the hammer, and also supporting the machinery necessary for putting the hammer in motion. The hammer consists of a plane bar of flat wrought iron so arranged as to work in the slides, and is raised by means of two vertical rollers turning in opposite directions, which are made to bear upon the bar by an exceedingly simple arrangement of levers. A slight pressure upon the handle of one lever raises the hammer to any height not exceeding 7 feet; the pressure being removed it falls by its own gravity—this lever is also arranged so as to stop the hammer in any part of its descent, should circumstances render it necessary. The friction rollers are put in motion by means of straps and pulleys, fly wheels being also fitted on each strap. A double punching and shearing-machine of great power, by the same inventor, has also just been completed at these works.—*British Mirror.*

The Archimedian Screw.—Although it is said to have been invented by Archimedes, and has long been named after him, there are circumstances which render it probable that those writers were mistaken who attribute it to the great philosopher of Syracuse. There is no evidence that Archimedes himself ever claimed its invention; and his countryman, Diodorus Siculus, who lived two hundred years after him, admits that it was invented in Egypt. Again; Vitruvius, who was contemporary with Diodorus, and had therefore equal opportunities of ascertaining the history of the invention, never once ascribes it to Archimedes, although he evinces a laudable anxiety throughout his work to trace every invention to its true author.

New Galvanic Battery.—One Laming Swan has taken out a patent in the United States for the employment in galvanic batteries of dilute sulphuric acid kept saturated by an alkaline sulphate. He says, however, that he limits his claim "to the use of the solution in batteries used for telegraphic purposes," that he "may not be supposed in any way to interfere with experiments, having for their object the advancement of science;" that is, he limits his claim to the only use of it, of which any profit can be made. Highly liberal this!

Mahomet's Coffin.—The suspension of this coffin in the air has been generally regarded as a fiction; but if we may credit a statement in Poncet's "Travels in Abyssinia," it is nothing more than has been accomplished in another case. He affirms that he beheld in a monastery in that country a golden staff about four feet long, poised in the air, without any visible support; and that, to detect any imposition, he desired leave to examine it closely, which was accorded to him, when, "to take away all doubt," he says, "I passed my cane over it, and under it, and on all sides, and found that this staff of gold did really hang of itself in the air."

Noah's Ark was in length six times its breadth, and in depth one tenth of its length. Most of our large steamers are built of the same proportions; and Mr. White asserts ("Treatise on Naval Architecture") that for stability and security none better could possibly be selected. The ark was twice as long, and twice as wide and deep as one of our West India mail steamers, and consequently it would take eight of them, considered as regular figures, to make a vessel as large as that which was freighted with the wreck of "the world before the flood."

Smithsonian Institution (*U. S.*) — At the late meeting of the association of American Geologists, Professor Henry gave a brief account of the founder of the Smithsonian Institute. He was a natural son of the Duke of Northumberland, of an amiable disposition, and much devoted to science. He was a great chemist, and on one occasion he observed a tear trickling down the cheek of a lady which he caught on a piece of glass, lost one-half and analyzes the other, and discovered a microscopic salt. He was the author of more than twenty original memoirs on various subjects, and felt proud of his scientific attainments. He had a soul far more noble than his father the Duke, and felt his own worth, as every talented man does, and on one occasion wrote thus: "The best blood of England flows in my veins—on my father's side I am a Northumberland

—on my mother's I am related to kings. But this is of no consequence. My name shall live in the memory of mankind, when the titles of the Northumberlands and Percys are forgotten." And truly shall his prophecy be fulfilled. Professor Henry said he could find no evidence that he had written this in view of the establishment of an Institution.—*Scientific American*.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Elizabeth Wallace, of Laurel-lodge, Cheltenham, Gloucester, spinster, for certain improvements in facing, figuring, designating, decorating, planning, and otherwise fitting up houses and other buildings, parts of which are applicable to articles of furniture. February 28; six months.

John Cross Roberts, of Holywell, Flintshire, surgeon, for a simplified and improved mode of communicating intelligence by means of electricity and magnetism, combined or not with steam, on railways between the carriages on the line and the engine or tender, so that the guards and passengers may give notice to the engineer, or engine driver, for the prevention of accidents or casualties, or the mitigation of the evils thereof, and the protection of human life and property from loss or injury, and also of communicating signals by the same agency, describing the cause or causes of alarm; and a new mode of securing the passage of electricity for the above purposes to be substituted or not for the side chains, and of communicating intelligence between distant places on the line. February 28; six months.

William Palmer, of Sutton-street, Clerkenwell, for improvements in melting fats and in the manufacture of candles. February 28; six months.

Charles Ritchie, of Aberdeen, Scotland, engineer, for certain improvements in locomotive and other engines. March 2; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Feb. 24	1371	Henry Cable	Bridge-road, Lambeth	Fumi-porte, improved chimney top.
25	1372	Joseph David Rankin	Enniskillen, Ireland	Safety coat.
26	1373	Henry Johnson and Co.	Stamford	Pelvipedic bath.
,,	1374	Thomas Craddock and Co.	Birmingham	Improved apparatus for working expansive steam valves.
28	1375	William Hayward	Northumberland-street, City-rd.	Carriage lamp.
29	1376	Walter Thornhill	New Bond-street	Blade of razor.
March 1	1377	Barnard Isaacs	St. James's street	Trousers.

NOTICES TO CORRESPONDENTS.

W. D. M.'s letter was accidentally overlooked. Address to the Albion Tavern, Covent Garden.

Communications received from Mr. Doull—R. Q. R.—Miles—A. V.—Mr. Harrison.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1283.] SATURDAY, MARCH 11, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

MR. CRADDOCK'S HIGH-PRESSURE, EXPANSION, AND CONDENSING ENGINE.

Fig. 1.

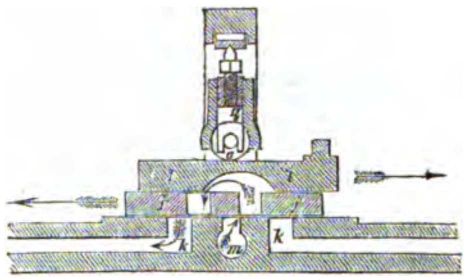


Fig. 2.

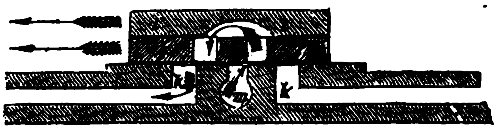


Fig. 3.

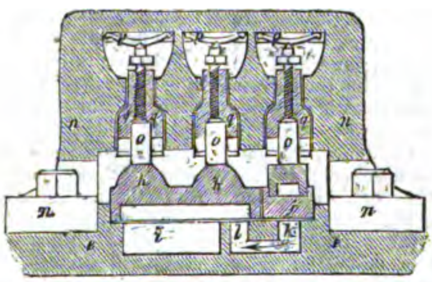
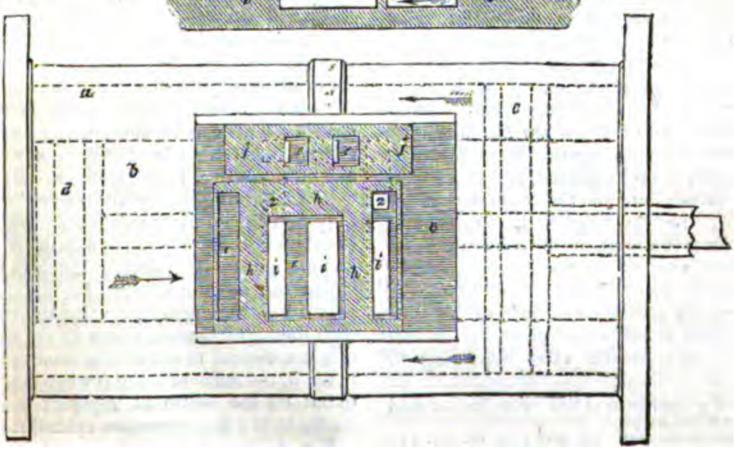


Fig. 4.



Sir,—I send you some further illustrations of the modes of applying my patent valve with the registered expansion apparatus,* and more especially the manner in which I apply the same to my patent arrangement of parallel cylinders, the pistons of which move in opposite directions, so that one such engine is made to work without a fly-wheel, by the cranks being set at such an angle that the crank attached to the large or low-pressure piston has passed sufficiently over the dead point, before that attached to the small or high-pressure piston has attained the dead point, by which the motion is continued.† The figs. from 1 to 4 show the manner in which this is effected. The cranks are not shown, but it will be seen that the large piston, *c*, which is supposed to be moving in the direction of the arrows, has passed some distance from the end of the cylinder; whilst *d*, which is the small or high-pressure piston, is just starting from the opposite end of the cylinder, and in the opposite direction, as indicated by the other arrow. *a*, is the large cylinder, and *b*, the high-pressure cylinder, supposed to be lying behind it; *eeee*, is the cylinder face, on which the valves work, which serve for the ingress and egress of the steam from both cylinders; *iii*, are the ports, which lead to each end of the large cylinder, and also to the condenser or atmosphere; *kk* (see figs. 2 and 3,) are the ports which lead to each end of the high-pressure cylinder; and *m*, is that through which the steam comes from the boiler. In this arrangement the high-pressure part of the valve is separated from the low; though in all cases, except when it is desired that one of the cranks should have the lead of the other (as shown by the pistons in fig. 1,) the valve for both cylinders is cast together, and is, in fact, one valve; but in the instance under notice, the dividing of the valve and attaching the high or low-pressure parts to their own separate eccentrics, admits of a more accurate setting for the ingress and egress of the steam into each cylinder, so as to suit an arrangement of this kind. *hhh*, is the valve belonging to the low-pressure cylinder, and, as seen in fig. 1, it is in section, having the back of it removed, so as to show the manner in which the steam passes from the high-pressure to the low-pressure cylinder, and also from the opposite end of the low-pressure cylinder, *c*, to the condenser or atmosphere. It will be observed that the long port in the valve, *h*, incloses the port, *i*, and the smaller port, 2, which communicates with the high-pressure cylinder; and hence the steam, which had previously driven the high-pressure piston to the end, or nearly the end of its stroke, is allowed to rush through the port, 2 and *i*, and the long hollow in the valve, *h*, to the large cylinder, *a*, while at the same time the exhausted steam is allowed to escape through the ports, *ii*, over the bridge, *e*, and, by means of the shorter, but wider hollow in the same valve, *h*, to pass off to the condenser. On the reversal of the valve, a reverse action takes place. The high-pressure valve is seen at *j*; it is also supposed, as there shown, to be in section, or with the back removed.

In fig. 1, it will be seen that the two valves are in positions corresponding to those of their respective pistons — the ports of the low-pressure valve being nearly wide open, while those of the high-pressure are just commencing to open. It may, perhaps, be well to observe, that as the communication is formed with the high-pressure cylinder before its piston has quite completed its stroke, the steam will be so far diminished in pressure, that it will now be made to act upon the two pistons; and farther, that the communication with the boiler and that end of the high-pressure cylinder must first be closed. This can be done, if the pistons are not desired to be much in advance one of the other, in the common way,— "that of giving lead to the valve," or it may be effected by the expansion valve, (as shown in fig. 3,) which admits of the pistons being, if desirable, much in advance one of the other. In fig. 2, is shown how the expansion valve traverses with the high-pressure steam valve, when it is not desired to cut off the steam; and in fig. 3, the mode of using it when desired to cut off the steam at any part of the stroke in the high-pressure cylinder.

Fig. 4, shows the communication be-

* For a description of this valve, see the third article of this Number.

† See *Mech. Mag.*, vol. xlvii., pp. 97, 121, 156. 169.

tween the small port, 2, which forms the communication through the low-pressure valve to the low-pressure cylinder, and also through the passages, *kk*, to the high-pressure cylinder. In figs. 3 and 4, is shown the manner in which the valves are held to the face, *eeee*, by means of the friction-rollers, *ooo*, which are supported by brackets, *nnn*, in small sliding frames, *qqq*, provided with adjusting screws, which act against the springs, *ppp*, so as to press the valve to its face with a force slightly greater than that of the counteracting force of the steam. In this manner all unnecessary pressure, which, in ordinary cases, produces great friction and wear in the valve, is removed. The order of the pistons may be reversed, if desired; that is, the high-pressure piston may take the lead, instead of the low-pressure piston, as shown above. THOS. CRADDOCK.

Birmingham, Feb. 29, 1848.

ILLUMINATED GLASS.

Sir,—The gullibility of the public is no doubt very great, but who would ever have thought in this enlightened age of an attempt being made to persuade a sane man that you could take his eye-glass, spectacles, opera-glass, microscope—nay, even his telescope—and, by the magical influence of prepared leather, render them capable of increasing the power of vision without affecting the focus of the lens employed? Some two or three years ago I saw this wonder tried, and was assured by the operator that plate glass and crown glass windows, when cleaned by the magic washleather, would become so illuminated as to transmit 20 per cent. more light into the apartment! Nay, that mirrors when operated upon became so singularly affected that you might see to shave yourself with the mirror on the mantlepiece and you standing at the other end of the room! A piece of glass rubbed with the leather was said to offer no appearance of any medium existing between the spectator and an object beyond the glass; and in the same way the very diamond became enhanced in value.

I am reminded of this extraordinary hallucination in science, if I may so term it, by a worthy friend in the country, who assures me he has received a most flattering account of the illuminated glass invention, and is anxious to have all the wrinkles and air-bubbles expelled from his mansion windows, mirrors, microscopes, and all his glass ware.

It is unfortunate to see any effort made to degrade science by attempting to connect it with such jugglery.

I am, Sir, yours, &c., SILICA.

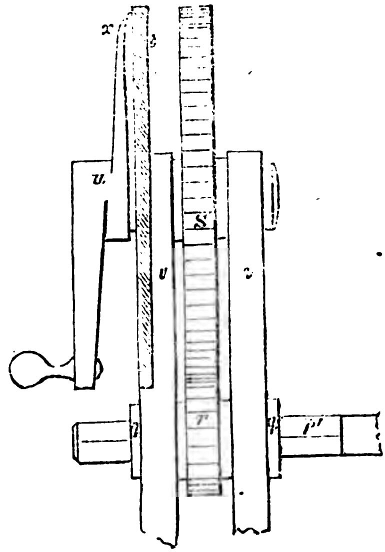
London, March 4, 1848.

MR. CRADDOCK'S APPARATUS FOR WORKING EXPANSIVE STEAM VALVES.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1 is an end elevation, and fig. 2 a side elevation, of this apparatus, the crossed parts in each of these figures being represented in section. In this design one eccentric, which is shown at 2222, is made to give motion to both the steam and expansive valves. The time at which it is desired to open and close the expansive valve, in relation to the stroke of the piston, will be best understood after describing the parts:—*dd*, is the clip and eccentric-rod which communicates motion from the eccentric, 2222, to the expansive valve, through the small weigh shaft, *e*, which is supported at the head of the movable lever, *ff*; *g* and *h* are two levers connected with the weigh-shaft, *e*—*g* being connected with the eccentric-rod, *d* and *h*, connected with the slotted lever, *j*, through the connecting-rod, *i*, which moves the worm-wheel, *kk*, that gears into the screw, *n*, which screw, *n*, by the parts, *mm*, (being forged together with the rocking-lever, *ll*,) gives motion through the valve-rod, *pp*, to the expansive valve. The part represented at *bb*, is supposed to receive its support from the same foundation as the main-shaft of the engine, *a*. The use of the part *bb*, is to support the head of the lever, *ff* (as shown in fig. 3.) The parts shown in fig. 3 are those by which the action of the eccentric is made to vary the time, so as to cut off the steam at any desired part of the stroke; *r*, is a small pinion, attached to that part of the square portion of the valve-rod marked *p'*, which projects beyond the expansive valve. The object of this portion of the valve-rod being squared, is that it should be at liberty to move freely to and fro through the pinion without disengaging itself from it. The square part is made to move through the bushes, *qq*, which bushes are square in their interior and round on the exterior, or part on which the valve-spindle, and the bushes along with them, revolves in the bearings at *vv*. When motion is given by the winch,

Fig. 1.



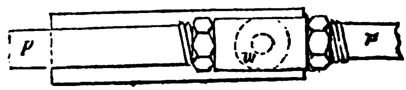
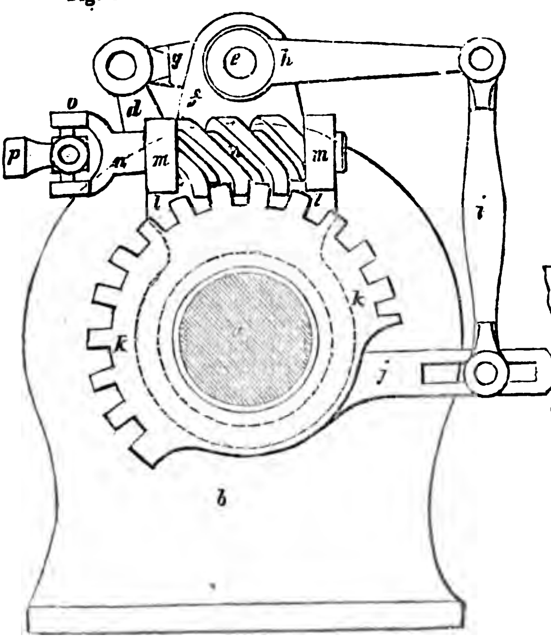
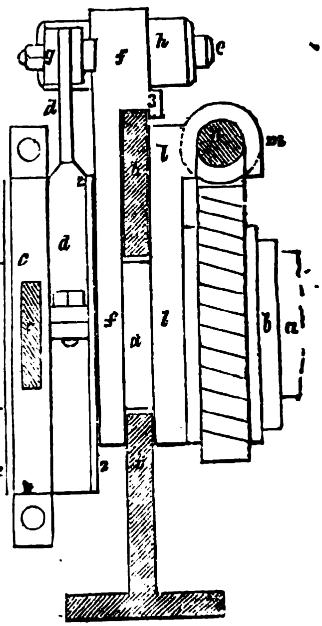


Fig. 3.

Fig. 2.





n, to the large wheel, *s*, the latter gearing into the pinion, *r*, causes the screw, *n*, to revolve, and thus to carry with it the worm-wheel, *kk*, and lever, *j*, and

hence to carry the eccentric-rod and clip, *dd*, round to any desired angle in relation to the main crank of the engine; which is the same thing as though the eccentric itself were moved round, thus governing the time of opening and closing the expansive valve. At *o*, is shown a universal joint, for the purpose of neutralising the vibration, which otherwise would be communicated to the valve-rod. At *w*, is shown the manner by which the valve-rod, *pp* and *p′*, is connected to the back of the expansive valve. At *t*, is shown in section an index-plate, and at *x*, a pointer, which being carried round by the winch, *u*, indicates upon the plate the fractional part of the stroke at which the steam is cut off. *cc*, is the clip and eccentric-rod, supposed to work the steam-valve.

By the above arrangement, the time of cutting off the steam by the expansion-valve is accomplished at pleasure, whilst the engine is at work, so as to adapt its power to a variable resistance. Should it be found desirable to work the expansion valve by a separate rod, and not by that marked *ppp*, this may be effected by having a circular slot in the worm-wheel, *k*, through which a pin attached to the lever, *ll*, may protrude so as to take hold of the valve-rod.

THOMAS CRADDOCK.

Birmingham, Feb. 29, 1848.

ON THE LAW OF THE FLOW OF WATER IN OPEN CHANNELS. BY WILLIAM DREDGE, ESQ., C.E.

(In continuation of papers on Sewage and Drainage from p. 77.)

It is easier to point out an error than to correct it—to raise objections than to remedy them. It is with such feelings as these that I am about to find fault with the formulæ usually applied to the flow of water in open channels; and though I do not apprehend any difficulty in demonstrating their insufficiency, I fear I shall not be so successful in suggesting a remedy.

It is strongly recommended in the Report of the Metropolitan Sanitary Commissioners, and it is much to be desired, that a series of experiments on the flow of water in open channels should be undertaken with a view of determining, if possible, the law regulating the discharge. Should these experiments be made, I hope their results will not be twisted into the formulæ at present employed; but that we shall have some original reasoning on the subject, such as will render the scientific investigation of real practical value.

In Dr. Gregory's "Mathematics for Practical Men," 1st Edition, p. 297, he says:

"Let V be the velocity of a stream measured by the inches it moves over in a second: R, a constant quantity, viz., the quotient obtained by dividing the area of the transverse section of the stream expressed in square inches by the boundary or perimeter of that section, minus the superficial breadth of the stream, expressed in linear inches.

"Lastly, let S be the denominator of a fraction which expresses the slope, the numerator being unity; that is, let it be the quotient obtained by dividing the length of the stream, supposing it to be extended in a right line, by the difference of the level of its two extremities, or, which is nearly the same, let it be the co-tangent of the inclination or slope.

"The above denominations being understood, and the section as well as velocity being supposed uniform; V in English inches

$$=\frac{307\sqrt{(R-\frac{1}{10})}}{S^{\frac{1}{2}}-\frac{1}{2}\log.(s+\frac{16}{10})}-\tfrac{3}{10}\sqrt{(R-\tfrac{1}{10})}\ldots(3).$$

"When R and S are very great

$$V=\frac{307\,R^{\frac{1}{2}}}{S^{\frac{1}{2}}}\text{ nearly}\ldots.(4)."$$

Taking an example, which occurs in the following page, of a river with a rectangular bed, whose breadth $=b$, and depth $=d$, when

$$R=\frac{bd}{b+2d},$$

and

$$V=\frac{307}{\sqrt{S}}\sqrt{\frac{bd}{b+2d}}\ldots.(5).$$

But as I have before observed (*ante* p. 177), and indeed it is stated in the following page of the work I have before me, that "when the sections of a river vary, the quantity of water remaining the same, the mean velocities are inversely as the areas of the sections." Therefore, if the areas of section of a river be n times greater in one place than they are in another, the quantity of water remaining the same, it follows that the velocity would be n times less at the

larger than at the lesser section, and if V be the velocity at the latter, $\frac{V}{n}$ will be the velocity of the current at the former section. Applying the above formula, and supposing the increased section to be caused by the widening of the stream—that is by b becoming nb, and putting R′ for the radius of curvature,

$$R' = \sqrt{\frac{nbd}{nb+2d}}, \text{ and,}$$

consequently,

$$V' = \frac{307}{\sqrt{S}}\sqrt{\frac{nbd}{nb+2d}} \ldots\ldots (6).$$

But according to the above remarks, V′ should be $= \frac{V}{n}$; dividing therefore both sides of equation (5) by n,

$$\frac{V}{n} = \frac{307}{n\sqrt{S}}\sqrt{\frac{bd}{b+2d}},$$

which should be equal to V′.

If it is, then

$$\frac{307}{n\sqrt{S'}}\sqrt{\frac{bd}{b+2d}} = \frac{307}{\sqrt{S}}\sqrt{\frac{nbd}{nb+2d}}, \text{ or } b + \frac{2d}{n} = n^2(b+2d),\text{—}$$

which is impossible, unless $n=1$; and therefore the formula for practical purposes is entirely useless.

I know it will be argued that these equations are intended to apply to those cases only, where the velocity and section remain uniform, or when $n=1$. The application, however, by Dr. Gregory immediately afterwards, of these very equations, to determine the increase of *depth* and *velocity* which a river will sustain by receiving the waters of another equal to itself, at once meets this objection. But even admitting the argument, the formula is still impracticable, for a stream of uniform section and velocity throughout its length is a case that can never occur.

Du Buat's formula, which I quoted in a previous paper, for computing the swell of a stream passing the piers of a bridge, recognizes the truth of this reasoning; for if the rise or swell of a stream occasioned by passing a bridge

$$= \left(\frac{v^2}{58\cdot 6} + s\right)\ \left(\left(\frac{r}{a}\right)^2 - 1\right).$$

Where r is the section before it meets the obstruction, and a the section between the piers, this takes into the equation the quantity a to represent the section of the stream whilst passing the obstruction, and therefore after it has swollen at the section r. If this be necessary for passing the temporary obstruction of a bridge, it must be much more so when that obstruction is extended along a lengthened channel.

The symbol S should not be taken to represent the inclination of the bed of the stream, but of the slope of the path, along which the centre of gravity of any vertical section passes, (as is represented and described, p. 206, fig. 1.)

Another objection of more general application is, that the only data involved in these formulæ are the quantities R and S, the one referring to the section under investigation, the other expressing the inclination of the stream. The nature and conditions of the river between the point at which the velocity is to be observed, and its mouth, are not at all noted; no symbols are used to indicate these conditions,* though, in my judgment, the nature of the problem requires them; for the flowing water at any given point in a river, is accelerated by an increased inclination of the bed of the stream, or is retarded by an obstruction that may occur in its course miles lower down the stream. The velocity of the current that precedes the falls of Niagara could not be represented by the equation

$$V = 307\sqrt{\frac{R}{S}}.$$

It would give a velocity greatly less than it really is; whilst, on the other hand, the same equation would show too high a velocity for a stream whose course is impeded by a mill-dam.

If a trench be dug in any direction, say due east and west, one end of which

* It should be here observed, that in consequence of the mechanical properties of a fluid, the conditions of a stream below any point of section, as affecting the velocity at that section, are faithfully indicated by the data existing at that point, if it were possible to collect the data; thus, the piers of a bridge cause a swell or rise in the stream, which increases the velocity between the piers; and whether we take the decrease of section or height of swell, the result indicating the increased velocity will be the same.

(suppose the west end) is closed with a sluice that can be removed at pleasure; then if this trench were filled with water and the sluice removed, the water would flow in a current from east to west. The motion, however, would commence at the west end, and go backwards towards the east. Here the motion is first caused by removing an obstruction from the mouth of the channel, and if any section of the stream be taken, the cause of the motion will be found subsequent to that section in the direction of the current. But, to take the converse of this—suppose the water to flow from east to west, and to be stopped by a sluice suddenly closed at the west end; then any section being taken, the cause which lessens the speed is subsequent to that section in the direction of the current.

It is rather extraordinary that Dr. Gregory, after stating that equation (5) referred to a stream of uniform section and velocity, should apply it immediately afterwards in determining the increase in section and velocity of a stream after its junction with another. As I propose now to refer to the effects of a subsidiary stream in increasing the sectional area and velocity of the current into which it flows, I will quote the example:

"Suppose that a river, having a rectangular bed, is increased by the junction of another river equal to itself, the declivity remaining the same, required the increase of depth and velocity.

"Let the breadth of the river equal the depth before the junction, d, and after it, x, and in like manner v and v^1 the mean velocity before and after; then

$$\frac{bd}{b+2d}$$

is the radius before, and

$$\frac{bx}{b+2x}$$

the radius after; so

$$v=307\sqrt{\frac{R}{S}};$$

and in like manner

$$v^1=307\sqrt{\frac{R^1}{S^1}}.$$

Then substituting for R and R^1, we have

$$v=\frac{307}{\sqrt{S}}\sqrt{\frac{bd}{b+2d}}; \text{ and } v^1=\frac{307}{\sqrt{S}}\sqrt{\frac{bx}{b+2x}}.$$

Multiplying these into the areas of sections, bd and bx, we have the discharges, viz:

$$bdv=\frac{307}{\sqrt{S}}\times\frac{bd\sqrt{bd}}{\sqrt{b+2d}} \quad \text{and } bxv^1=\frac{307}{\sqrt{s}}\times\frac{bx\sqrt{bx}}{\sqrt{b+2x}}.$$

Now the last of these is double the former, therefore

$$\frac{bx\sqrt{bx}}{\sqrt{b+2x}}=\frac{2bd\sqrt{bd}}{\sqrt{b+2d}} \text{ or } x^3-\frac{8d^3}{b+2d}x=\frac{4bd^3}{b+2d},$$

a cubic equation which can be solved by Cardan's rule."

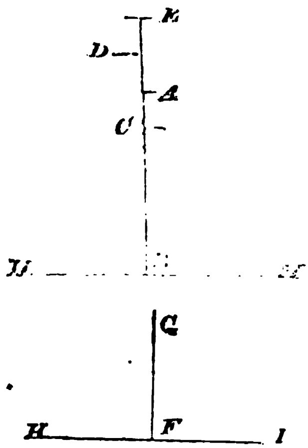
The very same sort of mistake, however, is committed by Zendrini, as quoted by Mr. Cressy, in his evidence before the Commissioners:

"I. A river which unites with another does not cause this latter to rise in proportion to the quantity of water which it brings, as would be the case supposing water to be considered as a solid, but only increases the height by as much as the greater or less velocity of the influent or recipient may permit. On the contrary, if a river in the middle of a canal be diminished by a certain quantity of water, it ought to be lowered proportionally to the velocity of the canal of derivation and the river from which the water is abstracted, and such an alteration ought to be perceived not only at the lower part at the point where the water is added or subtracted, but also in the upper. In which law, however, there is much obscurity; what appears certain is, that both in the case of the union and of the separation that the surface continually adapts itself to the alteration in a regular progression, and although the impression arising from such an anomaly does not disturb the whole level of the river if it runs over a long course, it reduces the problem to find the point where the disturbed mixes and unites with the undisturbed surface after following the oscillation of the water, which point in geometric rigour ought to traverse the whole length to the source of the river, since it would describe a regular curve; but the course of the water encounters so many impediments and obstructions, that these laws do not

really obtain. And in every river there is, in fact, a point beyond which the regurgitation does not take place.

"For the present it may be sufficient to seek the elevation or depression which will be produced in a river by the addition or subtraction of a quantity of water.

"II. Suppose A B to be the height of a recipient previous to the influx of another stream; let HM be its width in a given section, FG the height of the influent stream



before the union, HI its width. Supposing this latter introduced into the recipient, it ought to experience a certain rise. What will that rise be? Since the additional water ought to conform to the width of the section of the recipient, conceive the height, FG, of the influent altered to that of the recipient, AE, then the water of the one will have passed into the other, and since this fresh water presses upon the other, that of the recipient will be obliged to lower its surface, and from the point A will be brought down to C; likewise the point E will pass to D and ED = AC, and consequently, BD will be the entire height of the recipient after the addition of the influent water. Calling AB = d,* AE = x = CD, BD = z, FG = b, HI = a, LM = c, the velocity of the recipient before receiving the influent = u; its velocity after having received it, but before it could exercise any pressure and reduce it to equilibrium—that is the same which it would have if the water of the influent ran in the width of the recipient = t; the velocity which the recipient really has after the union and after the waters have equilibrated in their course = q; and finally the velocity which the influent had in its own level before the union = r. Then since the two masses of water of the influent and recipient in a given and equal time can pass separately in the level of the recipient, they ought to be able to pass together through the aforesaid recipient. Hence the equation $du + tx = qz$ and $z = \frac{du + tx}{q}$ first general formula; now since equal masses of water pass in equal times both through the influent separately and through the aforesaid influent when reduced to the width of the recipient, we shall have $ctx = abr$, whence $x = \frac{abr}{ct}$ and $z = \frac{cdu + abr}{cq}$ the second general formula expressing the whole height BD; wherefore AD, which is the whole increment produced by the influent above the first state of the recipient will be $\frac{cdu + abr - cdq}{cq}$."

Now if both streams are of equal section and velocity, then $cdu = abr = bdv = \frac{307}{\sqrt{S}} \frac{bd\sqrt{bd}}{\sqrt{b + 2d}}$, or $cdu + abr = \frac{307}{\sqrt{S}} \frac{bd\sqrt{bd}}{\sqrt{b + 2d}} \times 2$, and $\frac{cdu + abr}{cq} = z = x = \frac{2d\sqrt{bd}}{\sqrt{b + 2d}} \times \frac{\sqrt{b + 2x}}{\sqrt{bx}}$, or $cq = \frac{307}{\sqrt{S^1}} \cdot \frac{b\sqrt{bx}}{\sqrt{b + 2x}}$; hence, $z^3 - \frac{8d^3}{b + 2d} z = \frac{4bd^3}{b + 2d}$; which brings the equation identical with Gregory's.

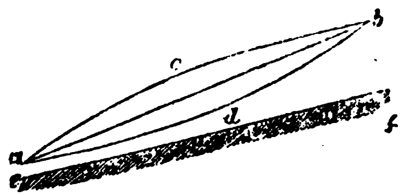
I had written thus far when I received the last number of your Journal, containing a review of the Report of the Commissioners, by the Rev. Principal Cowie; and as that gentleman's views differ from the opinions expressed in these papers, I would beg leave, before proceeding further, to pause, and consider that part of the review which clashes with the preceding observations. Eytelwein discovered that the velocity of a stream depended upon

* I have put the letters in Zendrini's equation, in this comparison, in Roman characters, to distinguish them from the same letters in Gregory's equation.

the inclination of its surface; but this in itself is insufficient to render the formula universally applicable. It may be argued, and apparently with great truth, that inasmuch as the increase of the velocity of the St. Lawrence as it approaches the Niagara diminishes the section of the stream, it thereby increases the inclination of its surface, and therefore since S, the denominator of the fraction expressing the inclination is lessened, the equation $v=3\cdot7\sqrt{\frac{R}{S}}$ would express the increase of velocity consequent upon the fall, and also that the value of S being increased by a mill dam across the stream, the same equation would show a slower velocity proportionate to the pent-up stream.

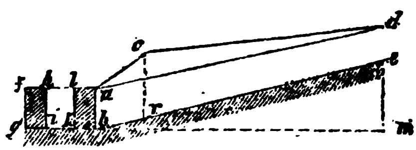
This reasoning however will not hold good in practice, because the inclination of the surface of the stream, which in the formula is represented by S, is not in the right line. If fig. (5) be the longitudinal section of a stream, *ef*, the bed of the river, then if there were no impediment to the water it would assume a curved line, *adb*, convex to its bed; and, on the other hand, if it meet with impediments, the surface would be concave to its bed, as represented by the curved line, *acb*.

Fig. 5.



It would be only when the friction equals the accelerating force, and the velocity becomes uniform, that the surface of the stream would be in the straight line, *ab*, and parallel to the bed of the river: and it is only in such cases that the formula can apply. As an example:

Fig. 6.



let fig. (6) be the longitudinal section of a stream, and suppose the friction equal to the acceleration of the stream, so that the surface of the fluid, *ad*, shall be parallel to the bed *bc*; let the section *fgab*, be the transverse section of the stream at *ab*; then the velocity of the water as it passes that section will by the equation

$$v=307\frac{\sqrt{R}}{S}=307\left\{\frac{\overline{em}}{\overline{bm}}\cdot\frac{\overline{ab}\times\overline{fd}}{2ab+fd}\right\}^{\frac{1}{2}}$$

Now if a bridge were built, the piers of which occupied the shaded parts of the section, so that the whole of the water of the river had to pass through *b i l k*, the point *a* would still be in the same position with respect to *d*, but the velocity of the stream at that point would be increased inversely as the transverse section.

Du Buat's formula for the height of the swell at *c*, consequent on the piers of the bridge, is

$$b=\left\{\frac{v^2}{58\cdot6}+s\right\}\left(\left(\frac{r}{a}\right)^2-1\right),$$

where *r* is the section of the stream at *c*, *a* the section between the piers, *s* the inclination of the bed, and *v* the velocity of the stream at *c*. *s*, being comparatively small, it may, without any very great error, be altogether omitted; wherefore, putting $v=4$ feet per second, $r=200$ feet, and $a=40$ feet, we have

$$b=\left(\frac{16}{58\cdot6}\right)\left(\left(\frac{200}{40}\right)^2-1\right)=6\cdot55 \text{ feet.*}$$

* In the table, page 308, of "Gregory's Treatise," before alluded to, the rise in a similar case is 7·775 feet; but he takes $s=\cdot05$ on an average inclination, which is much too great; for scarcely ever do we find an inclination of 1 to 20: 1 in 200, or $S=\cdot005$, would perhaps be nearer the mark. But, by omitting s altogether, the error, whatever it is, is against the odds for the above comparison.

Since the velocity varies inversely as the section, the quantity being the same, we have

section at a : section at c : : velocity at c : velocity at a, or 40 : 200 : : 4 : 20 = the velocity in feet of the water as it passes the channel $bilk$. But the point a, is in the same position whether the surface of the water is ad or acd, or, in other words, the mean inclination, S, is the same, whichever path the water takes.

At the point c the velocity is assumed to be = 4 feet = 48 inches; putting $fa = 10$ feet, and $cr = 20$ feet,

$$48 = 307\sqrt{\frac{R}{S}} \text{ or } S = \left(\frac{307}{48}\right)^2 R = \left(\frac{307}{48}\right)^2\left(\frac{fa \times cr}{2\,cr + fa}\right) = \left(\frac{307}{48}\right)^2$$

$$\frac{200 \times 144}{2 \times 20 \times 12 + 10 \times 12} = 1963 \text{ nearly,}$$

or the fraction expressing the slope from d to c is

$$\frac{1}{1963}$$

to give the velocity of 4 feet per second at c; therefore, if the channel be 5 miles long from d to c, the height of d above c is

$$\frac{5 \times 5280}{1963} = 13{\cdot}45 \text{ feet;}$$

and above a $13{\cdot}45 + 6{\cdot}55 = 20$ feet. Consequently the fraction expressing the height of d above a is

$$\frac{20}{2640} = \frac{1}{1320},$$

hence the velocity at a, if the bridge were removed, would be

$$V = 307\left\{\frac{1}{1320} \times \frac{fa \times ab}{2\,ab + fa}\right\}^{\frac{1}{2}} = 307\left\{\frac{1}{1320} \times \frac{10 \times 144\,(20 - 6{\cdot}55)}{12\{2\,(20 - 6{\cdot}55) + 10\}}\right\}$$

$= 46$ feet.

By which it appears that the velocity of the stream at a, when the surface of the water is ab, is 46 feet; but when the obstruction presented by the bridge exists in the proportion exhibited in the example, it becomes 20 feet per second.

I am perfectly aware that the above, and similar formulæ, are not intended to apply to streams of varying sections and velocities,—that "*Eytelwein's formula is inapplicable, and only refers to an open canal where the mean velocity is uniform from the canal head to the outlet.*" But of what use, let me ask, is a formula which applies only to an impossible case? The obstructions, it may also be said, offered by the bridge is an extreme case. Granted; but are not the obstructions which a stream meets in its course of precisely a similar character, though perhaps less in amount? There can be no doubt that the inclination of the surface generates the velocity; and if we could by any means ascertain the curve of the surface line, or by any possibility construct equations to it, it would be quite possible accurately to ascertain the velocity at any point: until we can do this, however, or something like it, I think that implicit reliance on calculations will be productive of evil rather than good. I would not be understood to doubt the accuracy of Eytelwein's formula with the data he takes, but I think that in practice it is impossible to obtain such data, and that for this reason the formula is useless.

(*To be continued.*)

ON THE USE OF GUTTA PERCHA IN ELECTRICAL INSULATION. BY PROFESSOR FARADAY.

[From the *Phil. Mag.* for March.]

I have lately found gutta percha very useful in electrical experiments. Its use depends upon the high insulating power which it possesses under ordinary conditions, and the manner in which it keeps this power in states of the atmosphere which make the surface of glass a good conductor. All gutta percha is not however equally good

as it comes from the manufacturer's hands; but it does not seem difficult to bring it into the best state: I will describe the qualities of a proper specimen, and refer to the differences afterwards. A good piece of gutta percha will insulate as well as an equal piece of shell-lac, whether it be in the form of sheet, or rod, or filament; but being tough and flexible when cold, as well as soft when hot, it will serve better than shell-lac in many cases where the brittleness of the latter is an inconvenience. Thus it makes very good handles for carriers of electricity in experiments on induction, not being liable to fracture: in the form of thin band or string it makes an excellent insulating suspender: a piece of it in sheet makes a most convenient insulating basis for anything placed on it. It forms excellent insulating plugs for the stems of gold-leaf electrometers when they pass through sheltering tubes, and larger plugs supply good insulating feet for extemporary electrical arrangements: cylinders of it half an inch or more in diameter have great stiffness, and form excellent insulating pillars. In these and in many other ways its power as an insulator may be useful.

Because of its good insulation, it is also an excellent substance for the excitement of negative electricity. It is hardly possible to take one of the soles sold by the shoemakers out of paper or into the hand, without exciting it to such a degree as to open the leaves of an electrometer one or more inches; or if it be unelectrified, the slightest passage over the hand or face, the clothes, or almost any other substance, gives it an electric state. Some of the gutta percha is sold in very thin sheets, resembling in general appearance oiled silk; and if a strip of this be drawn through the fingers, it is so electric as to adhere to the hand or attract pieces of paper. The appearance is such as to suggest the making a thicker sheet of the substance into a plate electrical machine for the production of negative electricity.

Then as to inductive action through the substance, a sheet of it is soon converted into an excellent electrophorus; or it may be coated and used in place of a Leyden jar; or in any of the many other forms of apparatus dependent on inductive action.

I have said that all gutta percha is not in this good electrical condition. With respect to that which is not so (and which has constituted about one-half of that which, being obtained at the shops, has passed through my hands,) it has either discharged an electrometer as a piece of paper or wood would do, or it has made it collapse greatly by touching, yet has on its removal been followed by a full opening of the leaves again: the latter effect I have been able to trace, and refer to a conducting portion within the mass, covered by a thin external non-conducting coat. When a piece which insulates well is cut, the surface exposed has a resinous lustre and a compact character that is very distinctive; whilst that which conducts has not the same degree of lustre, appears less translucent, and has more the aspect of a turbid solution solidified. I believe both moist steam-heat, and water-baths are used in its preparation for commerce; and the difference of specimens depends probably upon the manner in which these are applied, and followed by the after process of rolling between hot cylinders. However, if a portion of that which conducts be warmed in a current of hot air, as over the glass of a low gas flame, and be stretched, doubled up, and kneaded for some time between the fingers, as if with the intention of dissipating the moisture within, it becomes as good an insulator as the best.

I have soaked a good piece in water for an hour; and on taking it out, wiping it, and exposing it to the air for a minute or two, found it insulate as well as ever. Another piece was soaked for four days, and then wiped and tried: at first it was found lowered in insulating power; but after twelve hours' exposure to air under common circumstances it was as good as ever. I have not found that a week's exposure in a warm air, cupboard of a piece that did not insulate made it much better: a film on the outside became non-conducting; but if two fresh surfaces were exposed by cutting, and these were brought into contact with the electrometer and the finger, the inside portion was still found to conduct.

If the gutta percha in either the good or the bad condition (as to electrical service) be submitted to a gradually increasing temperature, at about 350° or 380°, it gives off a considerable proportion of water; being then cooled, the substance which remains has the general properties of gutta percha, and insulates well. The original gum is probably complicated, being a mixture of several things; and whether the water has existed in the substance as a hydrate, or is the result of a deeper change of one part or another of the gum, I am not prepared to say.

EXCITATION OF ELECTRICITY.

Sir, — In reference to the article headed "Curious Electrical Phenomena," (p. 203 of your last Number,) I beg to state that the discovery is not of so late a date as Mr. Barber supposes.

The electricity produced from paper has often afforded to me when a boy a ready means to charge a small phial, and to produce electrical coruscations. The paper I used was the common brown, and required to be thoroughly dried before the fire. It was then placed upon one knee, when a few smart strokes from the cuff of the coat, or a piece of India-rubber, would excite the paper. If the knuckle or the prongs of a fork were brought in proximity with it, a bright spark would be perceived capable of charging a small battery, &c.

About five years ago I constructed an electrical machine, using a circular disc of pasteboard instead of a glass plate, and which was driven at a great speed. It afforded very satisfactory results; but the principal disadvantages are these:—the disc requires to be warmed every time used, and the great speed causes an abrasion of the paper and the rubbers.

I am, Sir, yours, &c.,

ELECTRON.

Bristol, March 2, 1848.

P. S.—It is a well-known fact among paper-makers, who use machines, that the paper is highly electrical; as it leaves the drying cylinders to the reels, sparks are frequently seen to pass to any metallic bodies lying close to the reels.

MESSRS. MORDAN AND CO.'S COMBINATION COPYING AND SEALING PRESS.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1.

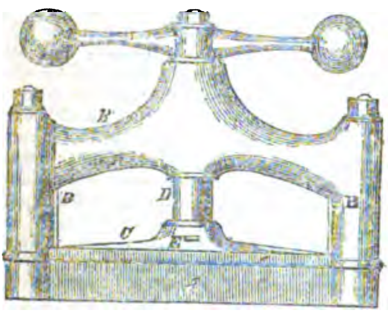
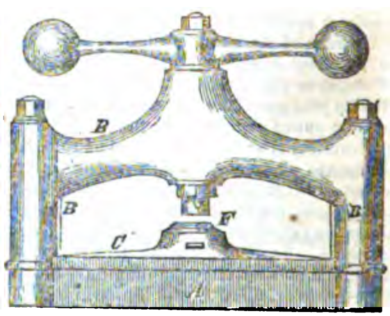


Fig. 2.



As in agriculture, one of the greatest achievements is to make two ears of corn grow where only one grew before, so in mechanics it may be considered a performance of somewhat analogous merit to do the work of two useful machines by means of one; and this is what Messrs. Mordan and Co. have very cleverly contrived to accomplish in the combination press before us.

Fig. 1, is an external elevation of a press as ordinarily constructed for copying letters; and fig. 2, is a similar view of the same, as now adapted to both copying, and sealing or stamping them.

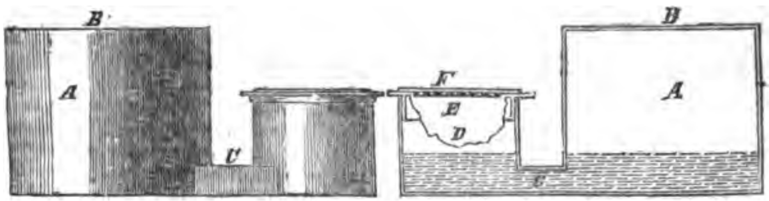
AA, is the sole plate; BB, the pillars and top, which are cast in one piece; C, the platten, which is connected to the tube of the screw, D, by a small pin, E, (as represented in fig. 1.)

When the screw, D, is turned in an upward direction, the platten follows it, and prepares the press for copying. When, however, the press is to be used, for stamping letters or other paper, then the pin, E, is withdrawn, and the platten thereby disengaged from the screw tube. A plain or figured disc of metal, F (fig. 2), is then inserted into the place in the platten, which had previously been occupied by the end of the screw tube, which piece, F, forms the rest for the letter or other paper, &c., to be stamped. The device of the stamp is either inserted into, or engraven on the end of the screw tube.

MESSRS. MORDAN AND CO.'S LABEL DAMPER.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1. Fig. 2.



Another very useful addition to the counting-house, from the prolific manufactory of Messrs. Mordan and Co. The Post-office authorities, in one of their earlier circulars after the introduction of the postage-stamps, recommended the tongue as the best sort of damper that could be used. But the use of the tongue in this way—at all times, and under all circumstances, a most unseemly and offensive practice—has latterly been denounced by the medical faculty as fraught with positive danger to the healthiness of the organ. A substitute for it became thus indispensable; and here we have it.

Figure 1, is an external elevation; and figure 2, a sectional elevation of the artificial damper of Messrs. Mordan and Co.. AA, is a chamber for containing water, the top or cover of which (B) is made of thin metal, slightly cambered on the upper side, so that when the finger is pressed upon it, the air in the chamber, A, becomes compressed, and, acting on the surface of the water, causes it to flow through the tube, C, up through the sponge, D, and filter, E, and saturates the cloth cover, F, upon which the gummed surface of the label is applied.

ELECTRO-MAGNETIC ENGINES.

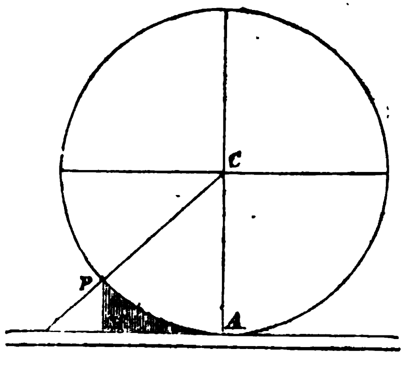
Sir,—I am happy to find that the subject of electro-magnetic motive power is being revived. It may, it is true, be of very doubtful practical utility; still it appears sufficiently plausible to deserve not only fair discussion, but a fair trial. It may probably be safely asserted, that the ponderous weight of locomotives, particularly on the Great Western Railway, has already arrived at the maximum of absurdity, and that the absorption of so much of the motive power by the dead weight of the machine in which that power resides, together with the destructive effect of this weight upon the rails and superstructure generally of the railway, is a very great drawback upon the railway system.

Any motive power, therefore, if even very much diminished in quantity—which would not be dependent upon—the resistent weight of the machine for adhesion to the rails would be a very great desideratum.

The objections of Mr. Macgregor to the plan proposed by Mr. Doull, in your last Number, for obtaining locomotive power by means of electro-magnetism, do not appear to be very formidable:—1st. There could be no very great difficulty in so forming the magnets of which the wheel would be composed in such a manner that a sufficient coil of wire could be passed round the magnets and still leave those portions near the periphery of the wheel separated from each other only

by a very thin non-conducting substance.

2nd. Granting, for the sake of argument, that the attractive force is "*perpendicular to the rail, and not to the magnet,*" does Mr. Macgregor mean to say that a power exerted in the direction MP, or rather in the whole of the plane, APN, perpendicular to the rail, would be "acting in the worst possible direction for the production of rotary motion" round the point A?



Perhaps Mr. Macgregor has too learnedly symbolized himself into erroneous views upon the subject.

I am, Sir, yours, &c.,

FAIR PLAY.

MATHEMATICAL PERIODICALS.

V.—*The Gentleman's Mathematical Companion.*—(Extracted Papers, *continued from* p. 226.)

ART. XXIX. On the Strength of Materials; containing Bernouilli's Problem of the Elastic Curve; *i.e.* the curve into which an extensible rigid body will be bent by a transverse strain. *Encyc. Brit.*

XXX. On Impulsion. *Encyc. Brit. Sup.*

XXXI. On the Figure of the Earth, as deducible from observation. From Bishop Horsley's *Elem. Treat.*

XXXII. A Demonstration of the Eleventh Proposition of Sir Isaac Newton's Treatise of Quadratures. By Ben. Robins Esq.: *Math. Tracts.*

*** To this paper is appended the demonstration of the following Lemma from the tracts of the same author: viz., "Quantities, and the ratios of quantities, which constantly tend towards equality during any whatever finite space of time, and before the end of that time, approach nearer together than by any whatever difference given, become ultimately equal."

XXXIII. Solutions of a difficult Problem in Astronomy. By Daniel Bernouilli and Euler: viz., "Given three altitudes of a star, whose declination is invariable, and the intervals of time between the observations, to find the latitude of the place of observation, the declination of the star, and the time of its culmination." *Petersb. Comment.*

XXXIV. Investigations relative to the Problem for Clearing the Apparent Distance of the Moon from the Sun or a Star, from the effects of Parallax and Refraction; and an easy and concise Method pointed out. By Dr. Brinckley: *Trans. Irish Acad.*

XXXV. To Determine the Height of the Tides at any Planet, caused by the attraction of a Satellite or other remote Body. By Thos. Simpson, Esq., F.R.S.

XXXVI. A Demonstration of the Law of Motion, that "A body deflected by two forces tending to two fixed points, will describe equal solids in equal times about the right angle joining those points." By Thos. Simpson, Esq., F.R.S.

XXXVII. An Easy and General Way of Investigating the Common Theorems relating to Compound Interest and Annuities, without being obliged to sum up the terms of a Geometrical Progression. By Thos. Simpson, Esq., F.R.S.

XXXVIII. A Solution of the Problem: "Supposing a circle to be described upon the transverse axis of a given ellipse as a diameter, and that a right line be drawn through two given points in the circumference of the circle to cut the ellipse; it is required to determine the lengths of those two segments of the right line, which are intercepted between the peripheries of the circle and ellipse." By George Witchell, Esq.

XXXIX. A Theorem of the Aberration of the Rays of Light Refracted through a Lens, on account of its spherical figure. By Dr. Maskelyne, F.R.S., *Ast. Roy.*

XL. The Demonstration of a very useful Lemma, concerned in the Investigation of the Height of the Tides and Precession of the Terrestrial Equinoxes: viz., "If S be supposed to represent the sun, T, the earth's centre, ABC, its surface; then the centripital force of the sun at S upon T, is to the perturbating force thereof upon a particle at A, P, or B, as ST to 3 TP, very nearly." By Mr. Thos. Allen, of Spalding.

XLI. A General Theorem relating to Regular Polygons: viz., "Let there be any regular polygon of (n) sides, described about a circle whose radius is (r), and let (ϕ) denote the angle at the centre subtended by a side of the polygon; let the distance of any point within the polygon from the centre be (v), and from that point let perpendiculars be drawn to the sides of the polygon. The area of the rectilineal figure formed by straight lines which join the bottoms of the adjacent perpendiculars, is equal to

$$n\left\{\tfrac{1}{2}r^2 \sin.\phi + \tfrac{1}{4}v^2 \sin.2\phi\right\}.$$

By W. Wallace, F.R.S.E.: *Edin. Phil. Jour.*

*** A corollary to the above theorem forms the 93rd Exercise on Book iv. of Mr. Potts' valuable edition of Euclid's Elements. No solution to this proposition is given in the "Appendix," but the above paper is referred to by Mr. Potts as containing a coordinate investigation.

XLII. Remarks on the Light of the Moon and of the Planets. By Sir John Leslie, K.H.: *Edin. Phil. Jour.*

(*End of the Extracted Papers.*)

Addendum.—Theorems referred to in art. 4, p. 155: "In the circle, ABC, the chord, AC, being drawn, and the arc, ABC, bisected in B, if D be taken in the circle at pleasure, and the lines BE, DF, drawn also at pleasure parallel to each other, one terminated by the circle E, and the other by the chord AC in F; then AD, DC, being drawn, BE, DF = AD, DC."

THOS. WILKINSON.

Burnley, Lancashire, Feb. 26, 1848.

(*To be continued.*)

THE ELECTRIC TELEGRAPH, THIRTY-FIVE YEARS AGO.

Sir,—In the "Repository of Arts," (vol. xxix., second series, p. 23,) is a communication from Mr. J. R. Sharpe, Doe Hill, near Alfreton, stating that he had exhibited before the Lords of the Admiralty, in February, 1813, "an experiment showing the advantages to be obtained from the application of the certain and rapid motion of the electric principle through an extensive voltaic circuit to the purposes of the ordinary telegraph."

This statement is made in consequence of there appearing in the same work, (vol. xxiv., second series, p 188,) an account of M. Soemmering's electrical telegraph, using an ordinary voltaic pile, and in relation to the success of which he says—"The first attempt fulfilled his expectations."

No doubt these particulars will interest many of your readers.

I am, Sir, yours, &c.,

H.

London, March 4, 1848.

THE TUBULAR BRIDGE OVER THE CONWAY.

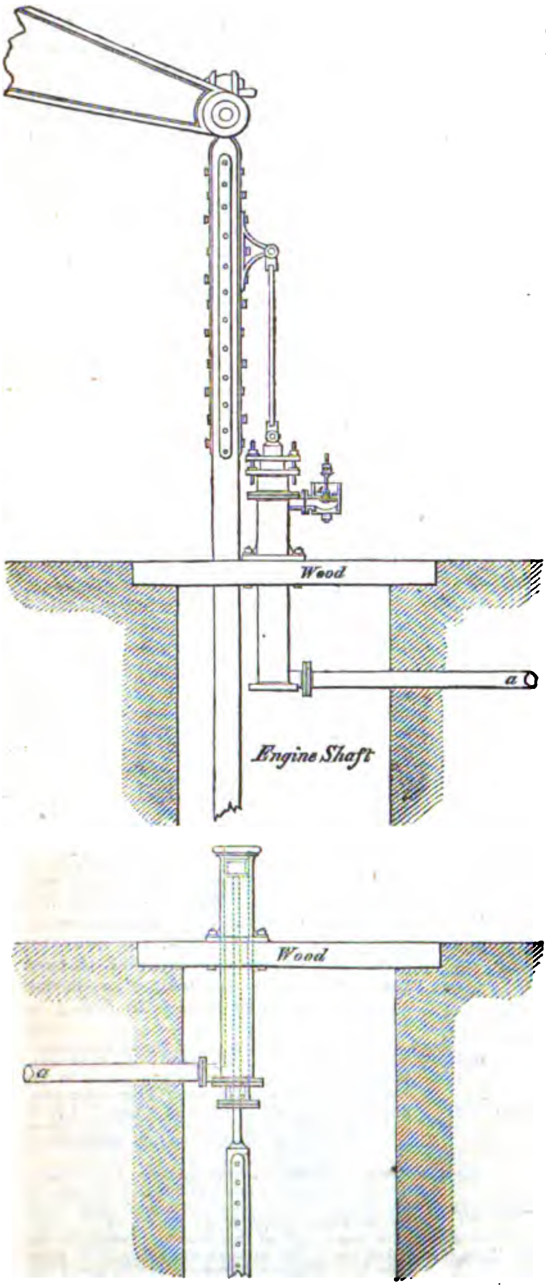
We make the following extract from a Report of the Directors of the Chester and Holyhead Railway Company to their shareholders:

"The Conway tube was, on the 6th of March, safely floated between the piers upon which it has to be raised; and the directors are fully assured by the engineer that within a month, at the utmost, from this time, the tube will be completely fixed in its place, and the trains enabled to pass through it. The bridge has already been subjected to a test, greatly exceeding any that it can ever be put to in its ordinary use. The tube, after having been suspended upon temporary piers, 400 feet apart, which is the full span of the bridge, was loaded with a weight of 300 tons, when the result was in every way most satisfactory. With the load of 300 tons, the deflexion was only three inches, or an inch to each 100 tons: and from that deflexion it completely recovered itself upon the weight being removed, after having remained therein for three entire days."

Height and Temperature of the Atmosphere.—According to calculations made by Sir J. W. Lubbock, the temperature of the atmosphere at the height of fifteen miles is 240·6° Fahr. below zero, and its density ·03573; while at a height of 22·35 miles it ceases altogether, or must at least be of such rareness as to afford no sensible resistance to the motion of bodies.

Spot on the Sun.—A spot has been of late observable by the naked eye on the face of the sun, of the shape and dimensions of a good sized bean. Mr. W. Pringle (*Phil. Mag.*, March, 1848,) calculates that a spot of that size to be visible to the naked eye at the distance of 95,000,000 of miles must be in diameter at least one-twelfth part of that of the sun, or about 66,000 miles.

HYDRAULIC SUBSTITUTE FOR THE FLAT RODS IN MINING MACHINERY.



We quote the following account of a singularly ingenious and useful contrivance from the *Mining Journal* of last week :

"We have frequently in our mines, arising from unavoidable circumstances, horizontal or flat rods, as we term them, for the purpose of communicating power from the engine to some other part, or parts, of the mine for pumping; and, on some occasions, to a great distance. These rods are invariably a considerable impediment to the engine, causing great friction, and preventing the carrying out the principle of expansion of steam—so very desirable as regards the economy of fuel—and also very frequently causing hindrances, and thereby considerable loss, to the mine. In order to do away with these things, it has occurred to me that water should be substituted, as per sketch*—it being exceedingly simple and effective, and may be applied to any situation—consequently, to any angle or curve. The plan, you will observe, is to have two pumps—one to be worked by the engine, and the other over the shaft or pit, where the power may be required in any part of the mine, and to be worked on the direct-action principle. The pipes leading from pump to pump, to be abont one-quarter the area of the pump—the weight being lifted on the outdoor's stroke of engine, will not, I think, require larger; and, in order to prevent any inconvenience on the in-door's stroke, I would have a small valve, as at *a*, to admit air, provided the water should not flow fast enough on the in-door stroke of engine, which air would be forced ont on the return of the water, and the valve will be shut by the raising of the water. The same valve should also take in such quantity of water as may be a sufficient compensation for any loss by leakage. The advantages to be obtained by this mode of

* The under figure is supposed to be a continuation towards the right-hand side of the upper one.

working are, that the whole of the work in any other part of the mine, to which it may be found necessary to communicate power, would be done by water-pressure, similar to a hydraulic or water-pressure engine—the spare power of the steam-engine acting as the column of water. The principle is easily rendered available underground, or on the surface, in whatever position it may be required; no risk of accidents by the derangement of flat-rods, bobs, &c.; and the engine to be worked, as regards expansion, as if doing the whole of the work in one shaft only. "JAMES SIMS.

"Redruth, Feb. 25, 1848."

SEWING MACHINES.

A machine for sewing has been recently exhibited by some French gentlemen, at the Royal Institution; but long before we heard anything of these parties, we quoted in this Journal (vol. xlvi., p. 256), from a New York paper, a notice of an invention for this purpose patented by an American. We now extract from the last number which has come to hand of the *Franklin Journal* the following particulars of the American invention:

The patentee (Elias Howe, jun.,) says,—In sewing a seam with my machine two threads are employed, one of which threads is carried through the cloth by means of a curved needle, the pointed end of which is to pass through said cloth: the needle used has the eye that is to receive the thread within a small distance, say an eighth of an inch, of its inner or pointed end. The other or outer end of the needle is held by an arm that vibrates on a pivot or joint pin, and the curvature of the needle is such as to correspond with the length of the arm as its radius. When the thread is carried through the cloth, which may be done to the distance of about three-fourths of an inch, the thread will be stretched above the curved needle, something in the manner of a bowstring, leaving a small open space between the two. A small shuttle, carrying a bobbin filled with silk or thread, is then made to pass entirely through this open space, between the needle and the thread which it carries; and when the shuttle is returned, which is done by means of a picker staff or shuttle-driver, the thread which was carried in by the needle is surrounded by that received from the shuttle; and as the needle is drawn out, it forces that which was received from the shuttle into the body of the cloth; and, as this operation is repeated, a seam is formed which has on each side of the cloth the same appearance as that given by stitching, with this peculiarity, that the thread shown on one side of the cloth is exclusively that which was given out by the needle, and the thread seen on the other side is exclusively that which was given out by the shuttle. It will, therefore, be seen that a stitch is made at every back and forth movement of the shuttle. The two thicknesses of cloth that are to be sewed are held upon pointed wires, which project out from a metallic plate, like the teeth of a comb, but at a considerable distance from each other—say three-fourths of an inch, more or less; these pointed wires sustaining the cloth, and answering the purpose of ordinary basting. The metallic plate from which these wires project has numerous holes through it, which answer the purpose of rack-teeth in enabling the plate to be moved forward, by means of a pinion, as the stitches are taken. The distance to which said plate is moved, and consequently the length of the stitches, may be regulated at pleasure."

Claim.—"Having thus fully described the manner in which I construct my machine for sewing seams, and shown the operation thereof, what I claim therein as new, and desire to secure by letters patent, is, first, the forming of the seam, by carrying a thread through the cloth by means of a curved needle on the end of a vibrating arm, and the passing of a shuttle furnished with its bobbin, in the manner set forth, between the needle and the thread which it carries, under a combination and arrangement of parts substantially the same with that described.

"I also claim the lifting of the thread that passes through the needle eye by means of the lifting-rod, for the purpose of forming a loop of loose thread that is to be subsequently drawn in by the passage of the shuttle, as herein fully described; said lifting-rod being furnished with a lifting-pin, and governed in its motions by the guide-pieces and other devices, arranged and operating substantially as described.

"I claim the holding of the thread that is given out by the shuttle so as to prevent its unwinding from the shuttle-bobbin after the shuttle has passed through the loop, said thread being held by means of the lever or clipping-piece, as herein made known, or in any other manner that is substantially the same in its operation and result.

"I claim the manner of arranging and combining the small lever with the sliding-box, in combination with the spring-piece, for the purpose of tightening the stitch as the needle is retracted, as described.

"I claim the holding of the cloth to be sewn by the use of a baster-plate, furnished with points for that purpose, and with holes, enabling it to operate as a rack in the man-

ner set forth, thereby carrying the cloth forward, and dispensing altogether with the necessity of basting the parts together."

NOTE, SUPPLEMENTARY AND EXPLANATORY. BY AN "EX-REVIEWER."

Dear Mr. Editor,—This is an age of "*ex*-es." We have *ex*-kings, *ex*-ministers, *ex*-chancellors, both of the court and the exchequer; we shall shortly have an *ex*-president and *ex*-secretaries of the Royal Society; and, to crown the whole, you have willed that I shall be "your *ex*-reviewer." Am I also to become a pluralist, by taking upon myself the character of your *ex*-correspondent? Your readers will have the consolation, at least, that you have

"A thousand men as good as he,"

ready and ardent to contribute to your work; and the gentleman of the "Temple" ("$\underline{+}$") will enjoy the satisfaction of having silenced the adverse counsel by the "authority of the court."

The mention of the Temple recals the memory of a note in your last Number, by a very different kind of Templar from "$\underline{+}$"—of a gentleman who, to the urbanity and liberality of his bearing towards other scientific men, adds a degree of mathematical power and originality of research in an intricate and difficult subject, which we see rarely equalled by even those to whom mathematics is professional. I feel it to be due to Mr. Cockle to express my sense of the high estimate I set upon his commendation of my lucubrations. At the same time, I seize the opportunity of assuring him that I had no intention to undervalue the importance of the step to which I referred as being made by Cardan, or Tartaglia, whichever it was that made it: the subject was only introduced incidentally, and perhaps, critically speaking, without sufficient definiteness for any other purpose than that for which I used it. I am as fully alive as Mr. Cockle himself to the important uses which have been made of the principle of which that is the first germ, in every department of algebraical research, but more especially in the treatment of algebraical equations (the *literal* equations I mean); and still more so in very recent times by Mr. Jerrard, Sir William Hamilton, and Mr. Cockle himself. The principle itself is perhaps fully appreciated, as yet, by but few mathematicians: but I am persuaded that it is destined to play a more important part than it has yet done, in the investigations of every department of analytical science. Mr. Cockle will then, I am sure, exonerate me from all suspicion of attempting to treat with contempt the man, whoever he be, that first hit upon the method in a single case: although I still think, that with him it was only "an expedient." Yet in how few great problems and great inventions of all kinds, is not this the initial step of their history?

A parting word or two is necessary on the subject of the last senate-house examination; but the *more especially* with regard to the manner in which Mr. Gaskin performed his functions as moderator. I had pointed out the dilemma in which he had placed himself; but at the same time expressed the most entire confidence in his acting as both his sense of honour and his reputation naturally dictated. He has, I am glad to say, fulfilled his duty as was anticipated of him. His geometrical questions were such that very few of them could be solved by the co-ordinate method without "a world of trouble," but which admitted of neat solutions by the Euclidean method. On the whole, therefore, I cannot but think that the most quiet and judicious mode of carrying out the intentions of the "graces" that could have been devised, has been chosen by Mr. Gaskin. It is indeed true that geometry does not even yet fill a *quite sufficiently* large space in the papers; but still the commencement is made, and if only very small additions be annually made in the quantity and difficulty of the geometrical "problems," three or four years will render the senate-house examinations all that can be desired in this respect. I tender to Mr. Gaskin both my congratulations and my thankfulness for the encouragement of the study of a branch of science which, in reference to education and social utility, is second to no one whatever.

I have been hoping to see in your pages the paper of Mr. Gaskin, on the "Inscription Problem," and trust you will be able to give it soon.* I see that our friend's historical paper on the subject is commenced in the number of the *Mathematician* just published: and I learn from him that he will very shortly arrive at the completion of his MS. It is desirable, for Mr. Gaskin's sake, that the paper he sent you should be noticed in that history.

And now with regard to Mr. Potts, and the "hard things" I am represented to have said of him. Nothing could be farther from my intention than to give pain to that able geometer and (from all I hear of him) most estimable man. I had, indeed, censured some of the assumptions of University society with respect to the manner of dealing with scientific property; but most assuredly if any one man be free from undue assumption on this head, it is Mr. Potts. He candidly gives his authority for everything for which he is indebted to any one but himself; and

* Yes; very soon.—Ed. M. M.

the suggestions that I offered for some slight changes of detail were offered with the kindest feeling, and with a sincere desire to see his work as faultless as such a work can be. At present it is, in my estimation, not only the best, but by far the best, edition of Euclid that has ever appeared *for the purposes of education.* I have said as much already; and I am astonished that any person could have construed what I said into severe censure—as I know has been done more than once.

As regards Mr. Colenso, had his book been the best of all possible books, instead of being an inferior one, and a mere "colourable variation" of Mr. Potts's (the false coloring, however, having spoiled the picture,) I could not but have condemned it in the strongest allowable language, on account of the *morale* of the transaction. It has, indeed, been insinuated that I am "hostile to Mr. Colenso, Dr. Hymers, and Mr. Snowball, because they *plucked* me when I sat for a scholarship at St. John's." I believe *you* know why I did not get a fellowship; but, at the same time, did you not know it, I am sure you would give me credit for a total absence of that baseness which would lead me to persecute those gentlemen on the ground of their conscientiously refusing me a fellowship in their college.

When composing those Reviews, I intended to add something more on the subjects under discussion—especially on "the *causes why,* for geometrical research, the Cartesian method *must always* be inferior to the ancient," and on the character, power, and perspicuity of "the *géométrié supérieur* of the modern French school." As, however, you have closed your pages against the subject, it is probable the thoughts that I intended to develop will float about for a few months in my brains during moments of reverie, and the subject ultimately vanish from amongst my speculations. I, at any rate, ask the favour of your inserting this explanation of some things which have given rise to misconception, as perhaps it is the last time I shall trespass on your pages. This I feel to be due to the gentlemen named, and I think you will feel that it is due to me too. I wish to part from all on good terms—or at least with mutual good understanding. As personal friends, however, I trust that you and I shall not be estranged, till the (to us) "end of all things" shall call one or other of us "home;" although "$\overline{+}$" has led to my signing myself,

Dear, Mr. Editor,

"YOUR EX-REVIEWER."*

Charles-street, Brompton, March 8, 1848.

THE "SARAH SANDS," AUXILIARY SCREW STEAMER.

Now that this fine ship has completed four voyages to New York, and is laid up for a short overhaul, previous to her next voyage, it may be interesting to review the results of her performance. She was built with a view to test the practicability of carrying on the general trade between this country and America by means of auxiliary steam power; and, judging by the results, the experiment seems to have been entirely successful.

In first attempts of this kind, allowance must always be made for difficulties in the machinery, arising from the novelty of the various parts, and such difficulties, though not of a serious nature, have been experienced, in this case no drawback has, however, appeared in the general principle.

It is well known that the New York packets are amongst the finest trading vessels in the world, and a comparison with some of the best of these on the outward voyage, where the greatest difficulties are encountered, will give a good idea of the performance of the *Sarah Sands:*

Sarah Sands.	*Sailed.*	*Time.*	*Packets Passed.*	*Average Time.*
1st Voyage	Jan. 20, 1847....	20½ days ...	...... 6	48 days.
2nd Voyage	April 6, ,, ...	23 ,, ...	...... 6	36½ ,,
3rd Voyage	June 15, ,, ...	34 ,, ...	...... 6	47 ,,
4th Voyage......	Sept. 3, ,, ...	20 ,, ...	...... 4	32 ,,

* We are sorry to perceive that "the Court" has been very much misunderstood. When it interposed its "authority" to put a stop to what promised to be a very unprofitable discussion on a particular point, it was far from intending to intimate anything like a wish for a general discontinuance of our esteemed friend's contributions; and deeply sorry should we be were our misinterpreted interference to have such an effect. We venture to hope, notwithstanding what has passed,

The third voyage was, in reality, twenty days, as—in consequence of injury sustained by one of the slide-valves—she put back into Cork, and lost fourteen days.

A fact connected with the last voyage is interesting. She took out a valuable, though light cargo—a large number of passengers, and coals sufficient to work her out and home, with eighty tons to spare, steaming the entire distance—a performance, we believe, wholly without precedent in the annals of steaming.

The *Sarah Sands* is an iron ship of 1,000 tons, builders' measurement, and 1,300, new measurement; engines, 180 horses power, coupled direct to the screw. She has an extensive accommodation for first, second, and third-class passengers, and can stow about 900 tons of goods, besides coals for the voyage.

She was built from the plans of Mr. Grantham, engineer, and is commanded by Captain W. C. Thompson, (late of the *Stephen Whitney*,) who superintended her outfit.—*Liverpool Standard.*

ROBERTSON'S IMPROVEMENTS IN THE MANUFACTURE OF METALS FROM THEIR ORES.

[Patent dated September 9, 1847. Specification enrolled March 9, 1848.]

The improvements which form the subject of this patent have been communicated to Mr. J. C. Robertson from abroad, and patented by him on behalf of the inventor, whose description of them we shall now lay before our readers. It may be proper to premise, that electricity has been before applied by Mr. Wall and others, to the extraction of metals from their ores; but not at the stage, nor in the way here proposed.

"It is well known that the ores of iron, lead, zinc, copper, tin, silver, antimony, bismuth, cobalt, and of most other metals, exist naturally as ores, in a state of combination with more or less of sulphur, phosphorus, arsenic, and other volatizible matters, from which it is important that they should be freed before being subjected to the smelting or reducing process. For this purpose, they are usually roasted in heaps in the open air, or on the hearth of a reverberatory or other furnace, with exposure to the atmosphere, it being requisite, in order to the volatilization of the matters which it is sought to get rid of, that the air should have access to the burning mass. But this roasting process is always tedious, and often so defective, that the ore, being but very partially freed from the sulphur, phosphorus, and other volatizible matters aforesaid, yields when smelted only a crude metal, possessed of neither the due malleability nor the proper lustre. Now the invention communicated to me, as aforesaid, consists in the subjection of the said ores to the joint action of heat and electricity, in manner following:—I have ascertained that when sulphurets, phosphurets, and arseniurets are under the influence of a high temperature, and have currents of electricity then transmitted through them, the sulphur, phosphorus, and arsenic, being naturally electro-negative, are powerfully attracted to the electro-positive pole of a voltaic battery, and have also their usual chemical affinities for metallic bases thereby impaired or subverted, so as to yield more readily to the volatilizing influence of the heat, and pass off in the state of fumes or vapour. The modeof carrying this invention into practical operation may be varied according to local circumstances; but the following description and directions will enable any practical metallurgist to execute and apply it readily on any working scale:

"A furnace or kiln may be employed of the form and construction of the ordinary lime-kiln, and with a surmounting dome. It is made somewhat of a pear, conical, or egg shape, and lined with well-burnt bricks, made of fire clay, and as free as may be from ferruginous matter, or with semi-vitrified bricks made by a due admixture of lime with clay and silica, in order that the lining may consist of materials which are to a great degree non-conductors of voltaic electricity, or at least bad conductors thereof. The grate-bars may rest loosely on cross bearings of iron, so that they may be easily shifted or replaced, as required. There may be an iron or fire-tile door at one side, a little above the level of the grate, for withdrawing the calcined ores.

"From the top or side of the dome a wide chimney proceeds, through which the vapours arising from the furnace either pass off into the open air or into some approved condensing apparatus.

"The mode of operating with the furnace is as follows:—The grate-bars are first covered with a layer of fuel (preferring good coke or anthracite, when it can be procured, to bituminous raw coal,) over which a layer of the ore (previously broken into small pieces, and sorted as usual) is laid; a second layer of fuel is then laid above the layer of ore, and over that second layer of fuel a second layer of ore; and so the operation of filling proceeds, the ore and fuel being piled up in alternate layers till the cavity of the furnace

that instead of this being his appearance for the "last time" on our stage, it will prove but the first of a new series of appearances, in which he will contribute as plentifully as of old to the instruction and delight of our readers.—Ed. M. M.

is filled. On the middle of the topmost layer an iron ring or cross should be laid. The undermost layer of fuel being kindled, it sets fire progressively to all the superjacent layers, and the roasting process begins.

As soon as any considerable portion of the mass has become moderately ignited, a communication is established between the iron ring or cross and a voltaic battery, or other equivalent electrical apparatus, by attaching to either of them a wire carried from the negative or positive pole of the said battery; while from the iron bearer of the grate-bars a wire is carried to the opposite pole of the battery, so as to establish the electrical circle and current through the mass of calcining materials. The electrical power should be proportional to the mass of materials operated on, and the action kept up until it is seen that the sulphurets, or phosphurets, or arseniurets, as the case may be, have been discharged, as evinced by the ceasing of the fumes. The battery should be one of the sustaining kind, or such that the current of electricity thus established through the mass should be steadily and well kept up. From the ring or cross of iron on the surface of the roasting materials, one, two, or more iron rods may be carried downward, either vertically or obliquely, into the contents of the kiln, through a greater or less extent, for favouring the conveyance and distribution of the electricity.

"The degree of strength with which the electric current acts, will be evidenced by the escape from the top of the furnace, in more or less abundance, in the form of fumes, of the sulphurous or other matters desired to be got rid of. The activity and power of the electrical current should be tested from time to time by transmitting it through a little acid and water in the test glass tube apparatus, well known to electricians, and described in most of the modern treatises on voltaic electricity.

"The lowest and best calcined portions of the mass are to be drawn off from time to time, either by the side doors of the furnace or from the grate itself, by removing two or three of the movable bars, after the manner commonly adopted in the draw lime-kiln.

"In proportion as the furnace is emptied at bottom, it must be replenished from the top with alternate layers of fuel and ore, as aforesaid, in order to maintain the mass always at the same level as nearly as may be; on which occasions the iron ring or cross may be removed during the time of feeding, and immediately afterwards replaced. The voltaic circuit should be also meanwhile interrupted.

"The ore, after it has gone through this roasting and electrizing process, is then to be washed and reduced, either in retorts, by cementation, or in a blast furnace, according to the modes in ordinary use."

The Inventor of the Jacquard Loom.—At the recent *soirée* of the Bolton Mechanics' Institute, Dr. Bowring told the following interesting story of the inventor of the Jacquard loom. He said, "I do not know, my friends, whether you have heard the name of Jacquard, or the Jacquard loom, which introduced so great an improvement into the manufacture of silks. I saw the old man only a few days before his death. The city of Lyons, in which he was born, and in which he had been terribly persecuted in early life, felt that it was due to him to make his declining days happy, and they gave him a liberal pension, which enabled him to pass the evening of his life in tranquillity and peace, and to purchase a pretty villa, to which was attached a beautiful garden, where I had an opportunity of hearing from his lips the history of his own experience. Perhaps you will allow me to repeat to you a few remarks of that extraordinary man, made to me, seated with him in his bower, fairly and truly under the shade of his own vine and his own fig tree, and on a beautiful summer evening, when the sun was setting, and when the decline and setting of that sun reminded me that the sun of Jacquard was setting also, for he was weak and about to be lost to his generation. Jacquard was a straw-manufacturer in the city of Lyons; he was a poor man, and he had received little instruction. During the war with England, there was an article appeared in the French *Moniteur*, which stated that a person in England had offered a large sum of money to any man who could produce a machine by which a net could be made. This set him to work, and he did get over the great difficulty of producing a machine by which a knot could be tied. The thing was forgotten, and by some accident this net was given to the great Emperor Napoleon, and he was told that a poor man on the banks of the Rhone had solved a very great and difficult problem. Jacquard, in great poverty, one day, and scarcely knowing how to exist, was surprised by the visit of a serjeant of *gens d'armes*, who knocked at the door. He came down stairs, and the serjeant said. 'I have orders to take you to Paris.' He said 'Who has sent for me at Paris?' he was told, 'Why you will hear that when you get there. There is a carriage waiting for you.' He said, 'I must send for my wife, and make preparation;' but the serjeant said, 'No, you must go as you are;' and he was taken to the Palace of the Thuileries and instantly introduced to two persons—no less distinguished than Napoleon Bonaparte and his great minister, Carnot. Napoleon said, 'They tell me you say you can tie a knot in a straight string (for that is the art of knitting,) by a piece of machinery; I don't believe you.' He continued, 'Now, in order to try you, I will have you locked up in an apartment, and supplied with materials upon which to work, and everything you require to make your machine.' Well, Jacquard set to work so locked up, and constructed a machine, was covered with honour, continued to direct his attention to mechanical art, and afterwards produced that machine which bears his name, and to which I have referred, and which, by merely throwing the shuttle across the warp, produced the most beautiful patterns. These machines produced a revolution in France; thrice they rose upon Jacquard; twice they attempted to drown him in the Rhone. He withdrew himself from the world for many years, still attempting to be the benefactor of his native land. Opinion changed, however, and, as I told you, before he died, he was the recipient of a liberal pension, not only from the city of Lyons, but from the French Government. He died upon the property which was conveyed to him, the grateful gift of the people he had honoured and elevated; and when he was carried to his tomb, the city of Lyons declared that his portrait should be painted and hung in the School of Arts, where I have seen it.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Francis Whishaw, of Hampstead, Middlesex, civil engineer, for a certain manufacture of pipes of earthenware, pottery and glass, and of certain applications and arrangements thereof. March 8; six months.

William Exall, of Reading, Berkshire, for certain improvements in thrashing machines, and in steam boilers, engines, and other apparatus for driving the same, which apparatus is applicable to driving other machinery, part of which improvements are a communication, and the remainder is his own invention. March 8; six months.

James Lochhead, of Milton, Gravesend, Kent., gent., for certain improvements in ventilation. March 8; six months.

Theodorus Cornelius Seegers, knight, of Saint Gravenhage, Holland, but now of Leicester-square, Middlesex, physician, for improvements in the construction of railway carriages. March 8; six months.

William Beckett Johnson, of Liverpool, engineer, for certain improvements which are applicable to locomotive, stationary, and marine steam engines. March 8; six months.

Warren de la Rue, of Bunhill-row, Middlesex, manufacturer, for improvements in machinery used in the manufacture of cardboard and pasteboard. (Being a communication.) March 8; six months.

John Houston, Stepney, Middlesex, surgeon, for improvements in obtaining motive power by the aid of atmospheric air, and in obtaining combustion. March 8; six months.

George Boyce, of Fletland, Lincoln, miller, for improvements in machinery or apparatus for depositing, cleansing, and grinding corn and seed. March 8; six months.

George Lloyd, of Stepney, Middlesex, iron founder, for certain improvements in furnaces and blowing machines, and improvements in engines and machinery for driving the same, which improvements are also applicable to other purposes where motive power is required. March 8; six months.

Joseph Maudslay, of the firm of Maudslay, Sons, and Field, engineers, for certain improvements in obtaining and applying motive power, and in the machinery and engines employed therein. March 8; six months.

John McConochié, of Liverpool, and Louis James Claude, of Bootle, Lancaster, civil engineers, for certain improvements in locomotive engines. March 8; six months.

Alexander Alliott, of Lenton Works, Nottingham, bleacher, for improvements in apparatus used in the working of steam boilers, also in apparatus used in cleaning flues. March 8; six months.

John Henderson Porter, of Blackheath, Kent, for improvements in iron girders, beams, trusses, and supports, and in rendering the floors of buildings fire-proof by the use of iron. March 8; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Mar. 2	1378	Benjamin Cogswell......	Strand	Revolving and self-priming pistol.
3	1379	Doulton and Watts	Lambeth Pottery, Lambeth	Drain-trap.
4	1380	Richard Gede Marshall,	Cheltenham, ironmonger	Inkstand cover.
7	1381	Mark Freeman	New-road, Streatham	Parts of a blow-pipe.
8	1382	Hunt and Roskell	Old Bond-street, jewellers	Safety shirt-stud.

To Engineers and Iron Founders.

PERLBACH'S PATENT PROCESS of uniting Metals and Alloys, described in the *Mechanics' Magazine*, No. 1277, will be found very useful for strengthening Iron Castings by inserting bars or pieces of Wrought Iron and for uniting Cast Iron with Copper, Steel, Gun Metal, Brass, and other Alloys.

For Licenses and Particulars, apply to Mr. C. A. Preller, 31, Abchurch-lane.

To Spinners of the Finest and Shortest Wool.

FOR LICENSES FOR PRELLER'S Patent Wool-Combing Machines, apply to Messrs. Passavant and Co., Bradford, Yorkshire, or to Mr. C. A. Preller, 31, Abchurch-lane.

Gutta Percha Company, Patentees,

Wharf-road, City-road, London.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in Bands of an indefinite length, render them superior for almost all working purposes, and decidedly economical.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Haslingden, September 4, 1847.

Dear Sir,—We have now been using the Gutta Percha Straps for the last eight months, and have great pleasure in saying they have answered our most sanguine expectations; and we may add, that some of our machines which required a 12-inch leather strap, and which almost daily required to be repaired, we have been turning the same with the Gutta Percha Straps 10 inches only for the above-named period, and now find them as good as the day they were first applied.

We remain, yours respectfully,
W. & R. TURNER.

To S. Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

Sir,—In reply to your inquiry as to the result of our experience with the Gutta Percha Straps, we have great pleasure in stating that the advantages they possess are so very manifest as to induce us to apply them in almost every instance where new straps are required.—We are, Sir, very respectfully,
SHARP, BROTHERS.

Samuel Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

Sir,—In reply to your inquiry respecting how we like your Gutta Percha Machine Straps or Driving Belts, although we have not had quite so much experience in the above-named use of Gutta Percha as we hope to have, so far as we have employed it it has given us general satisfaction. The beautifully straight and regular manner in which it runs on the pulleys, especially on our cone or speed pulleys, is a strong recommendation in its favour; and although we are inclined to think it does not take so fast a grip on the pulley as leather, yet there is ample hold for all general purposes. We shall continue to use it and to give it our best attention, so as to learn how to employ to best advantage the many excellent qualities it possesses over the ordinary leather belts.

NASMYTH, GASKELL, & CO.

S. Statham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

Dear Sir,—We beg to inform you that we have now had the patent Gutta Percha Bands or Straps in use for more than six months. For tube frames we consider them very much superior to anything we have tried before. They also do very well as open straps for mules, throstles, looms, &c.

We are, Sir, yours respectfully,
THOS. DODGSHON & NEPHEWS.

Mr. Samuel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

Gentlemen,—We have much pleasure in bearing our testimony to the valuable qualities of the Gutta Percha for driving bands. We have found it answer exceedingly well in most cases where we have tried it, and we think it has only to be made known to ensure its very general use.

We are, Gentlemen, yours obediently,
HOLE, LINGARD, & CRUTTENDEN.

To the Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

Dear Sir,—Your letter of the 31st August is to hand, and in answer respecting the use of your Gutta Percha Bands, I cannot give you a better proof of our approval of them in preference to leather straps, than having given an order for another to your partner, yesterday, to be in readiness in case of accident. They are decidedly preferable to the old straps; and we can recommend them with the greatest confidence to any person for Driving Straps.

For HALL & GORTON, THOMAS GORTON.

S. Statham, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.

Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.

TRUMAN, HANBURY, BUXTON, & CO.

To the Gutta Percha Company.

Patent Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as lea-

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CONTENTS OF THIS NUMBER.

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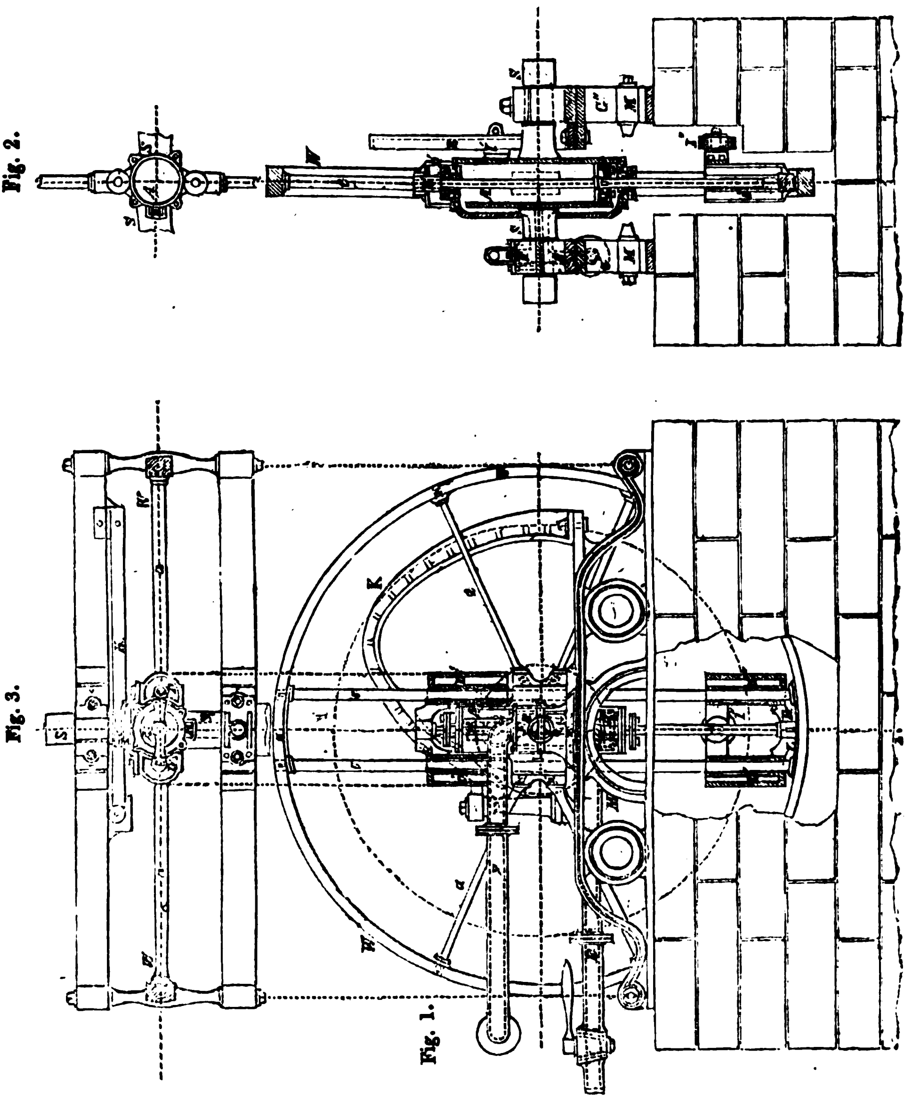
Edited by J. C. Robertson, 166, Fleet-street.

MR. SIMS' NEW STEAM ENGINE.



MR. SIMS' NEW STEAM ENGINE.

[Patent dated September 9, 1846. Patentee, James Sims, Esq., C. E., Redruth. Specification enrolled March 9, 1847.]

NOTHING so new or remarkable as this, in the class of steam engine improvements, has appeared for a long time. Mr. Sims has already attained to great eminence as a steam-engine builder, as is witnessed more especially by his double piston expansion engines, and their unrivalled pumping performances; but in the present instance he has gone much beyond all his previous efforts. He claims to be able, by the plan of construction we are now about to describe, to obtain a greater effect, in proportion to the fuel expended and steam produced, than has been ever heretofore accomplished; and this he well may, for all the duty he now asks of the steam to perform is, to turn, as it were, a scale, and leave certain weights thrown into that scale, to do the rest. Such steam, too, as he does require, he uses expansively, and pushes that expansion to the utmost: the consumption of steam is thus reduced to the very lowest point to which it is, in all likelihood, possible to carry it. The office of the steam in this engine is simply to shift certain weight-blocks to and from the centre of motion; the power of the engine being mainly derived from the gravity of these blocks, when brought into certain positions. The system may be applied either to rotary or reciprocating engines; as is explained in the following extracts from Mr. Sims' specification:—

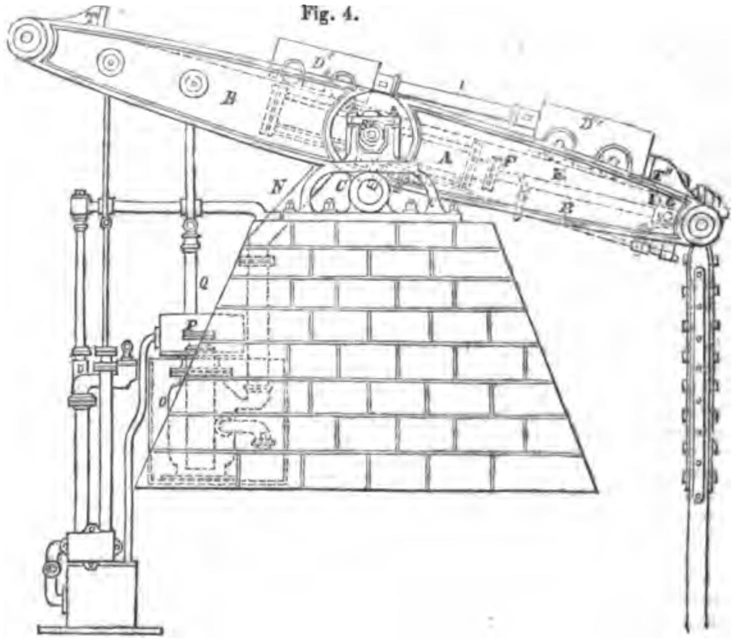
My invention has, firstly, relation to the class of steam engines which operate by direct rotary action, and has for its object to simplify the construction of such engines, and reduce the cost thereof, as also to obtain a greater effect therefrom, in proportion to the fuel expended and steam produced, than has been ever heretofore accomplished. And in figures 1, 2, and 3, I have exhibited so much of a high-pressure engine, constructed according to this branch of my invention, as is necessary to exemplify clearly the nature of the same, and in what manner it is to be carried into effect; fig. 1 being a side elevation of the parts shown; fig. 2 transverse section on the line *ab* of fig. 1; and fig. 3 a plan. A, is a steam cylinder, which is mounted in the centre of a fly-wheel, W; S, the shaft of this wheel is in two parts, cast upon or otherwise attached to two opposite sides of the cylinder, A, while the spokes or arms, *aaaa* and *cccc*, radiate from brackets or snugs BB, cast upon or otherwise attached to the two other sides of the cylinder, A. P is a piston, which fits the cylinder in the same way as in ordinary steam engines, but has two arms or rods, one on each side of the piston, which work alternately through stuffing-boxes at the opposite ends of the cylinder. R′R″ are cross heads, which are attached to the extreme ends of the piston-rods, and slide upon and are guided by two of the arms *cccc* of the wheel, which are placed for the purpose parallel to one another, and at equal distances from the cylinder. D′D″ are weight-blocks, which are attached to the cross heads R′R″, and provided with guide-rollers I′I″, which take alternately into the parabolic guide-plate K. H is a steam-pipe or passage cast on the cylinder, and communicating with it at top and bottom. The shaft S, before mentioned, is cast hollow, and divided longitudinally into two separate passages x, y, one of which leads to the upper, and the other to the lower end of the cylinder, through the passage H. E is the induction port, and F the eduction port, which are formed of two longitudinal slots or openings made in the journal of the shaft S, which rests on two pedestals or pillow-blocks G′G″, raised on the basement M, for the support of the engine. The mode of setting the engine to work is as follows:—Supposing the engine to be at rest, and the valve or cock which commands the induction port E to be opened, (the eduction port being at the same time left open to the exhaust-pipe), the steam immediately rushes beneath the piston, and presses it upwards, carrying with it, through the medium of the piston-rods and cross heads, the weight-blocks D′D″. But as soon as the guide-roller I′, attached to the weight-block at the extreme end of the upper piston-rod, comes into contact with the parabolic guide-plate K, it not only deflects the piston in the direction of that plate, but throws over the upper weight-block from the centre of the wheel into a line coincident with the pressure of the piston, and simultaneously therewith brings the under weight-block up to the centre. As the piston completes its stroke, the upper weight-block D′ is thrown out to the extreme length of its range, and then serves, by its gravity, combined with the impetus derived from the preceding stroke of the steam piston, to carry round the wheel through the remaining half of one revolution (as represented in fig. 1,) by

which time the cylinder is in a position to receive a second charge of steam, when the same operation is repeated as before, and the entire revolution completed; and so on for any number of revolutions, as long as the engine is supplied with steam. The weight-blocks, it will be observed, are prevented by the guide-plate from being thrown out so far as to come in contact with the periphery of the wheel; but that guide-plate is not absolutely required, except where the engine is worked with variable loads, and it may be safely dispensed with wherever the engine has one steady and uniform duty to perform; and in the latter case, it will be proper to attach to the inside of the periphery of the wheel, between the arms *cccc*, two paddings or buffers LL of vulcanized caoutchouc, or of gutta percha, to protect the periphery from any accidental concussion of the blocks against it.

The weight-blocks must always bear a due proportion to the mean power of the steam, or, in other words, the terminal pressure of the steam should always be just sufficient to hold the two blocks in equilibrium, until the one which is uppermost for the moment, is thrown over from the centre towards the descending side of the wheel. The bulk of the blocks may, however, be considerably diminished by casting them hollow and filling them up with lead.

In order to avoid any inconvenience which may attend the enlargement of the cylinder and wheel, where an increase of

Fig. 4.



power is required, there may be two, three, or more wheels of medium size attached to one shaft, or there may be two or more cylinders, mounted in one wheel, placed at angles proportionate to their number; as for example, if two cylinders are used, they should be at right angles; and if three, they must be at angles of 30° apart. The power of the engine or engines may be transmitted either from the shaft or through the medium of bands carried round the wheel or wheels, and when requisite, the rotary motion transmitted may be converted into a rectilineal one by any of the ordinary and well-known methods of effecting such changes. An engine of this sort is more especially adapted to be worked by high pressure steam, and on the expansion principle, because of its offering no limit to the extent to which the expansion may be carried; it may, however, be readily worked also on the condensing principle, by carrying the exhaust pipe into a condenser, with air-pump attached to it.

N 2

The engine is represented in the figures as calculated to revolve in one direction only, but should it be desirable to have the power of reversing the motion, that may be easily effected by having a second parabolic guide plate on the opposite side of the wheel, and providing some suitable means of causing the guide-wheels to shift from the one plate to the other.

Secondly. My invention consists in the construction of a reciprocating steam-engine on the same principle as the rotary one before described; namely, that of employing the steam to shift weight-blocks to and from the centre of motion, and turning to account the power derived from the gravity of these blocks when brought into certain positions. Fig. 4, represents a side-elevation of a pumping engine on this plan; B is the beam which works or moves on the gudgeon B^2, or centre of motion, and is supported by the pedestals or pillow blocks CC. A is a steam cylinder (shown in dotted lines), which occupies a place between, and is attached to the two sides or halves of the beam B. To the piston (which works from one end to the other of the cylinder, as in ordinary engines,) there is attached a rod, E, which passes out through a stuffing-box, F, at one end, and carries at its outer extremity a cross-head, G. D′ D″ are two weight-blocks placed at a short distance apart, but connected by a wrought iron rod, I, which are mounted on wheels, and run on rails affixed to or cast on the sides of the two halves of the beam. The cross-head G of the piston-rod is connected to the weight-block D″, which is next the pump-rod; so that whatever motion is given to the piston is communicated, through the medium of the cross-head, to the weight-blocks. The steam is admitted into the cylinder through a port in the main gudgeon, or centre of motion; and the induction valve is worked by a tappet, I, so adjusted that the steam obtains admission under the piston only when the beam is in an inclined position, and the piston is at the lower end of the cylinder; while on the other hand the exhaust pipe, N, is always open for the escape of the steam from the higher end of the cylinder to the condenser O. P is an air-pump which is worked by the rod Q. The mode of working this engine is as follows: As the steam piston moves from left to right and right to left, it passes one block over the centre of motion while the other block is passed to the extreme end of the beam, when it is there stopped by the horns or abutments TT′, which limits its range. The gravity of the weight-block so passed over the centre, depresses the end of the beam equivalent to the length of stroke of the pump, and when the weight-blocks are again passed from right to left, the end of the beam is again elevated. The motion of the engine is thus kept up by passing continuously the weight-blocks from right to left and left to right.

I consider this form of engine to be particularly adapted to rectilineal pumping purposes, but it may also be applied to rotary purposes, through the medium of a connected rod and crank, in the ordinary way.

The great simplicity of this sort of engine—its cheapness and portability—the small cost at which it can be worked—and the various purposes to which it can be applied—are all strong circumstances in its favour. We should, *à priori*, have anticipated that the motion would be somewhat unsteady, and the friction considerable; but a practical engineer of great intelligence and experience, who attended for two entire days the working of an engine in Cornwall, constructed on the rotary plan, described in the first part of the specification, assures us, that the motion, on the contrary, was singularly equable and smooth throughout, and never once interrupted by any derangement of the parts.

ON SANATORY REFORM. BY H. M'CORMAC, ESQ., M.D.

Sanatory reform is a subject of momentous interest. It is nothing less than the health or ill-health, the premature destruction or the reverse, of the human raçe. Nature, providence, doubtless designs that man should enjoy a protracted career; but brief, indeed, is the term which circumstances allot to the vast majority. It is now tolerably well known, at least to the thinking part of the community, that we are poisoned with bad air in our houses and out of our houses; that we drink foul water; that drainage is insufficient, and that our dwellings are inadequately heated. On the working-classes, more especially, do these evils press. I would rather, however, dilate on remedies than on evils; and first, as to heating and ventilation.

These two, of necessity, go together; we cannot, at least we should not, heat if we do not ventilate; and ventilation in winter is best accompanied with warmth. We heat houses with open fires, or by means of stoves, steam-

pipes, and hot-water. In open fires, however, the greater portion of the caloric goes up the chimney, whereas in close stoves the air becomes impure. Now, if the Flemish stove-grate were employed, the open air might be introduced between the stove and its casing; and thus agreeably heated, escape into the apartment, and permeate it in every direction. The ingress and egress of air might be regulated by hand, or automatically by means of thermometer valves, so as to realise the temperature found most agreeable. In humble establishments, a cooking apparatus might readily be attached; also hot chambers for drying or airing clothes. Flemish stove-grates properly arranged, and placed in halls or on landings, would create a wholesome, genial atmosphere, which would pervade the house, extend to the different apartments, and neutralise the present unwholesome draught from doors and windows. In large dwellings a hot chamber containing a brick or iron stove, might be expedient in the basement story; connected with this a hot chamber, the open air finding admission below, and when heated, escaping through suitable apertures above. It would be quite practicable in constructing a house, whether of brick, stone, or iron, to lead tubes from a hot chamber to the different apartments. Hot chambers even might be formed under floors, resembling the Roman *hypocaust;* but superior, inasmuch as pure fresh air would be admitted and emitted. Here, however, a fire-proof floor would be necessary, unless when steam or hot water was the heating agent. Hot chambers might obviously be connected with ordinary fires —kitchen-ranges—Russian, Dresden, in short, porcelain, iron, and brick stoves, of every description. In all cases, however, there must be a copious supply of pure fresh air through apertures of adequate dimensions.

Ventilation, whether as regards the family apartment or the large assembly-room, is a simple matter, provided we keep a few obvious considerations in view. Impure heated air gathers at the top of each apartment; we have only to make one or more openings and let it escape. But foul air will not sufficiently escape unless *more air* supply its place. According to the old system, this duty was left to doors and windows, entailing much discomfort, and not unfrequently disease. Abundance of warm, moist, genial air should find entrance beneath the doors, through apertures in the skirting, and even the floor itself; also from the hot-chamber behind the stove-grate, if there be one in the apartment. Longitudinal invisible apertures might likewise be constructed above the architraves of the doors. The heating of halls and staircases by means of ventilating stoves, would prove a real source of health, comfort, and economy. The free admission of *cold* air can only be resorted to in summer. In Russia and other cold countries, where *ventilating* stoves are unknown, the air of living-rooms is sadly contaminated. As for our own sitting apartments, they are neither adequately heated, nor adequately ventilated.

There are two modes of letting off foul air: one is by a sufficiently large opening into the chimney; the other is by means of tubes running up with the smoke funnels, and terminating in an angular space beneath the roof, whence the air escapes through cowls or proper louvre openings. Fresh, air, however, will not come into the apartment, nor will the foul air adequately escape, unless the inlets and the outlets be of sufficient dimensions. These dimensions will vary with the size of the apartments; but I would say, suffer plenty of pure, warm air to enter, and see that it has a copious outlet. Any ordinary chimney-funnel will, of course, suffice, provided the opening into it be large enough; but if a separate conduit be preferred, it should be of at least nine inches diameter for a room of medium dimensions, and the inlet the same. Which of these modes is preferable, I do not take upon me to say. When an Arnott's valve has been placed in the breast of the chimney, I have witnessed regurgitation of smoke—a drawback to which the collateral funnel would not prove liable. I should prefer the opening in the centre of the ceiling; below this, a *ventilating* lamp. It does not matter much, probably, whether we employ the smoke-funnel or another, so we employ one; or whether the opening be at the centre or side of the apartment, so that it be large enough. If a central opening be approved of, the foul-air duct, lined and covered with tiles bedded in plaster, may be led towards the chim-

ney between the joists. If the joists lie the wrong way, a coffered ceiling would allow the tube or duct to lie in one of the intersections. Or if beams supported the ceiling, one of them might be made hollow; or, finally—as use is before beauty—a simple tube could be attached below the ceiling. It would not do to lead the conduit directly into the open air, as there would be a blow-down. In any case, if the duct led into the chimney, it would be necessary to make a provision for removing possible obstructions at its outlet. I have only to add, that all rooms, houses, jails, workshops, palaces, factories, churches, school-rooms —in short, wherever human beings live and breathe—should be well ventilated in winter, by the copious admission and free discharge of air, artificially heated; in summer, by the free admission, night and day, with the proper precautions, of the atmosphere.

To light a house well, is next in importance to heating and ventilating it. The importance of light is not sufficiently appreciated. The absence of pure, warm air, is productive of disease; but the absence of light is productive of disease and deformity. It should gush in copious streams through every aperture. Windows should extend to the very ceiling, and be made to clean with safety and facility. The introduction of plate-glass windows is among the great improvements of modern times. A tax on light is a disgrace to civilization; and to shut out light is both hurtful and absurd. Every house cannot have a southern aspect; but, if possible, the sun should shine at least a portion of each day on the front and rear of every house. The absence or deficiency of this gift of heaven is at once productive of disease and gloom.

Every house should have an adequate supply of pure, soft, sweet water, at all times available, and extending to every apartment. In the sleeping rooms, indeed, there should be a marble or slate bath, with hot water, and an outlet for the superfluity. A common, or a steam boiler, in connection with the kitchen fire, would supply the baths; supplies even might be obtained from the earth itself. With the improved facilities for boring, artesian wells might be sunk in most situations: the artesian well at Grenelle, in Paris, emits hot water copiously. I do not see why public companies should not undertake to furnish towns, on easy terms, with water both hot and cold. Tubes to convey hot water should be double; the interval being well stuffed with some non-conducting substance, as pounded breeze or charcoal, in order to economize the heat. The hot water of the Grenelle must lose a great deal of its caloric owing to this omission. We do not, perhaps, sufficiently avail ourselves of the beneficence of nature. Mechanical attrition, likewise compressed air, yields supplies of heat, of which we might take advantage: the earth is willing to yield hot water; and the electric fluid, while it is already the speedy messenger of thought, promises, at no distant period, to light up our streets and houses. These, with vast mechanic power, and other benefits yet in store for us, we may enjoy if we will.

It is not enough however, to heat, light, and ventilate, unless proper arrangements be made for getting rid of the excretions of the human frame. On the various contrivances for this purpose it is needless to dilate; but the apartments where they are situated, should be effectively ventilated, as well as sufficiently cut off from the body of the house. Many houses, even of a superior stamp, are next to uninhabitable from omissions in these respects. A syphon valve seems best; and there should be a drip of solution of sulphate of iron, or lime and chlorine, cheap and efficient deodorizers. The tubes also should be packed, to guard them from frost. It is now conceded by competent judges, that glass or earthenware is the preferable material for foul or sullage pipes. The tubes should be connected by a coupling, or otherwise, with perhaps gutta percha, or vulcanized caoutchouc joints, so as to be readily detached and renewed. It is most monstrous to suffer the feculent discharges of whole streets to escape into the drainage-water conduits, poisoning the health and comfort of the inhabitants. The foul drainage should be isolated in tubes, say of 9 or perhaps 12 inches in diameter; and discharging their contents into reservoirs, constructed of fire-brick, dipped in asphalt, the whole on a concrete foundation. Gutta percha tubes, with couplings, would permit these reservoirs to be pumped out at intervals. Night

or early morning should be chosen for the operation, at the close of which, chlorine or copperas should be poured into the cavity. When these reservoirs are placed on the banks of navigable rivers, boats could be employed to convey the refuse; in other situations, tumbrils.

The practice of tearing up streets and roadways in order to arrange gas or water pipes, should be discontinued. I would propose culverts, high enough to permit the parties in charge to walk erect under every thoroughfare. If constructed of fire-brick laid in asphalt on a concrete basis, they would last for ever. They would yield ample space for sullage, gas, and water-pipes, as well as for electric wires; and so far from entailing the great expense they now do, would probably be a source of revenue from the payments which companies would gladly make for permission to use them. There should be a foot-path on each side, to enable men to pass: and a water way for the rain water, say 6 or 8 inches deep in the centre. The tubes might rest on suitable supports, stone or metal. The culverts themselves would be in the charge of inspectors who would admit the servants of the different companies. It would be practicable to light them by means of blocks of cast glass placed above. The rain-water drainage should be through grated-syphon valves, grated with wire-gauze, so as to exclude everything except water. The gratings could be made on the principle of a purse to draw out and clean. The streets and lanes I would have daily swept; and if the roadways were constructed of double lines of large granite curb, say a foot over, the intervals of gravel bedded in asphalte, the whole on a concrete foundation, it would yield the utmost facilities for permanence and cleanliness. The curbs, I may add, should be so hewn, as to allow the four sides to be alternately turned up. A roadway of this description, even in London, should last for centuries with occasional repairs. The advantages of no longer having street or house drains mere vomitories or outlets for excrementitious gases, inflicting their poisonous and death-dealing miasmata on high and low, rich and poor, young and old alike, would be unspeakably great. The finest streets of our metropolitan, to say nothing of provincial towns, are thus polluted; and must continue to be so, to the unavoidable prejudice of all concerned, till some sweeping measure of reform be realized. It would not be necessary to have these culverts with any specific inclination; in other respects, should any obstruction ensue in the water or sullage pipes, hydraulic pressure, couplings being left for the purpose, would readily overcome it.

Human dwellings should be invariably *above* the level of the ground; while all direct communication with the soil should be cut off by asphalte, or plaster of Paris, over a concrete foundation or basis. Houses already built could thus be readily isolated, to the utter exclusion of one source, at least, of stench and humidity. The practice of laying the floors of living-rooms, even in superior houses, on joists directly over the damp, perchance reeking, soil is a monstrous abuse. The dwellings of the poorest even, could be rendered comparatively comfortable, as well as free from damp and vermin, at a small expense, only using the precaution to place a flagstone at the fireplace. *All* houses would be rendered at once both healthier and more comfortable if the inner walls were panelled with wood rendered fireproof. The dwellings of the poor should be universally reconstructed: the investment would be excellent.

A justifiable repugnance has risen up in regard of burial in and near towns. It is unnecessary, as it is revolting, that the remains of the dead should poison the abodes of the living. At Naples, the burying-ground, or *campo santo*, contains 365 pits, one of which is used for the current day, then closed for a year. It has been proposed to take a piece of ground, and erect a pyramid of the dead, closing up each several coffin with plaster. Some would return to cremation, or burning: this would effectually restore the poor relics of humanity to the elements. The deep sea would afford a burial-place that could never become over crowded. It would be possible to fall back on the Egyptian system of embalming. The difficulty is not overcome by the mere removal to the country, since the burying-places now subsisting must soon become surcharged with the numberless dead. Now the whole difficulty may in a moment be

overcome by abandoning the practice of *superficial* interment. Lay the dead *deep* in the bosom of the earth: *there* the space can never be over-crowded. Suppose large receptacles, aired and lighted, constructed in the ground,—disused quarries and mines might be turned to account,—the dead might be placed in recesses capable of containing any given number of coffins, then instantly sealed up with asphalte or plaster, beyond pollution or exposure for ever. The interment of the poor should be gratuitous. Relations might accompany their friends to a suitable repository, where the religious rites which their convictions dictated could be performed, and whence the remains could be nightly removed to their final resting-place. It is quite unnecessary, as it seems to me, that another interment should take place in London or any other city: Dartmoor, or one of the abandoned mines of Cornwall or Lancashire, thanks to railways, being just as accessible as a few miles out of town by any other conveyance. So long as existing grave-yards continue to be made use of, it might be rendered compulsory to lay the remains at such a depth, say fifteen feet, as would preserve them inviolate.

Ventilation and perfect cleanliness, the public may be well assured, would keep infectious disorders thoroughly at bay. Baths and wash-houses should subsist in every parish, free of cost to the poor. Tepid swimming-baths would be very desirable. The temperature of the *air*, as well as that of the water, should be carefully raised. There should be gratuitous reading-rooms, heated, lighted, ventilated; with books, newspapers, prints, plaster casts; automatic music, that might repeat the glorious strains of Handel, Mozart, Beethoven. Picture galleries, museums, parks, gymnasia, opened and covered, should be everywhere accessible. Let us make places of *innocent* recreation attractive, and they will successfully compete with the bagnio and the dram-shop; vice, with its unfailing attendant, disease, would be discountenanced; while intelligence, decorum, and public health, would be promoted; for health, and morals, and cheerfulness, are never far asunder. Multiply, I would say, places of healthy, innocent, and improving resort, and you lessen the expense with the necessity of hospitals, lunatic and other asylums, jails, with all their sad and miserable accessaries. You would then promote the health of the body, and you would promote the health of the soul—for the habits of the very humblest portions of society entail results that ultimately affect the whole. The most selfish exclusionist is led from time to time, and now perhaps more than ever, to feel that his welfare is not so much a thing apart, as shut up in his personal enjoyments he may have been led to imagine. The pestilence that rages in the hovel does not always spare the palace. In fact, the welfare of mankind is indisseverable; and, irrespective of higher conditions, by promoting the moral and physical amelioration of the masses, we intimately serve ourselves as well as those who are to come after us.

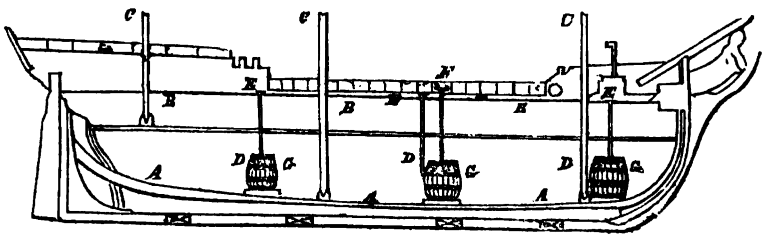
Belfast, March 15, 1848.

THE VENTILOMETER.

A new instrument under this name, invented by an officer of the French navy, has been recently submitted to our Lords of the Admiralty. Hitherto winds have been supposed to be caused chiefly by changes in the density of the atmosphere; but the inventor of the ventilometer professes to have discovered that they originate entirely from "electrical changes," though, perhaps, influenced secondarily by the pressure, more or less, of the atmosphere; nay, that their approach may be as truly predicted by the magnetic needle as the degree of deviation of a vessel's course from due north. The instrument, in fact, exactly resembles an ordinary ship's compass. The ventilometer forms itself (we quote a description which is going the round of the press) "into the centre of a certain undefined circumference, but the extent of whose influence does not exceed a space of twenty-four hours; any change taking place within this circle is notified—so that, suppose a vane to be pointing north, but that the ventilometer at the same moment points to south; then, within the twenty-four hours, *most certainly*, the south wind will blow; but the ordinary change is from twelve to eighteen hours, and should the ventilometer remain for hours, or days, at the same point, the same wind will continue blowing; but when it changes within the twenty-four hours, the wind will change also. This instrument is not influenced by the lighter breezes; when a strong wind blows, the needle, or indicator, is horizontal —but as the winds, or atmospheric changes,

gradually increase in violence, the point is elevated by the weight of the atmosphere, and thus not merely preindicates the wind that is to blow, but its exact strength and duration." We hope all this may prove true; but in the absence of any sufficient reason for the wonderful effects ascribed to the instrument, we must needs have our doubts. The Lords of the Admiralty will of course order it to have a fair trial.

PLAN FOR THE SUPPRESSION OF SPONTANEOUS COMBUSTION ON BOARD SHIPS. BY W. BLAND, ESQ.



[In 1839 a vessel called the *Dispatch*, freighted with wool from Sydney, took fire from the spontaneous combustion of the wool, and was entirely destroyed, the crew and passengers with great difficulty escaping with their lives. In 1832 another vessel, the *Lady Raffles*, also laden with wool, ignited in the harbour of Sydney, and was only saved from the like utter destruction by being scuttled and sunk—having been raised again after the fire was extinguished. These occurrences led the author of the present paper to consider whether some ready means could not be devised of averting such disasters,—whether, for example, it might not "be possible to inundate (if the term may be so applied) the entire hold and cargo with some gas, the presence of which would be incompatible alike with that of the combustive process (in whatever stage) in the cargo, and with the combustion itself." Several gases suggested themselves. Of these, the carbonic acid appeared in an especial manner to possess all the requisite, and the fewest objectionable properties. The great obstacles to its application seemed to consist in the dense stowage of a wool cargo, and the necessity of introducing the gas to the lowest regions of the hold. However, the great specific gravity of this gas, and its high expansive power, especially when heated, presented the obvious means of overcoming these difficulties. Mr. Bland, therefore, persevered, and perfected the very clever and efficient apparatus, which is described in the following paper. Notices of it have appeared in most of the Sydney newspapers and magazines, and we now gladly lend our aid to make it more widely and generally known.—Ed. M. M.]

Place on the kelson of the vessel, before it has received its lading, three (3) casks, one for each hold, the upper fifth or sixth of each cask to be pierced with numerous holes, each about an inch in diameter, the rest of the cask to be lined internally with lead. Insert and fasten into the head of each cask, or into the upper part of one of its sides, a metallic tube, about 2 ins. in diameter, to extend as required, from the cask to the upper or main deck—the whole length of each tube to be protected with a strong casing of wood.

To prepare the above apparatus for immediate use, put into each cask, *when placed where it is to stand*, a due quantity, which will be explained presently, of carbonate of lime—(whiting, chalk, or limestone, or marble broken into small fragments will do)—and should there at any time be reason for suspecting the commencement, or the actual existence of combustion, (the hatches having been carefully battened down,) pour on the carbonate of lime in that cask which may happen to be nearest the spot where the combustion is supposed to have commenced (by means of the tube attached to it), about one pint of water to each pound of the carbonate contained in the cask, to be followed with 6 ounces by measure of strong sulphuric acid, or 8 ounces of nitric

acid, or 8 ounces of muriatic acid, poured in slowly, a gill, or less, at a time. A disengagement of carbonic acid gas, more or less rapid, as the carbonate may be in a state of more or less minute division, and as the acid may be poured upon it more or less slowly, would now take place—when the gas escaping through the perforations in the upper part of the cask, would, by its own weight, and its vast expansive power, force its way along the lower regions of the vessel, until, stratum by stratum, it had expelled and replaced any other gaseous fluid, or had become mixed with it in those proportions in which it would be destructive of combustion.

In order to facilitate the mixing of the dilute acid with the carbonate of lime, it would be advisable if whiting or chalk should be used, for creating a more rapid supply of the gas, and the sulphuric acid, for cheapness, to add to the apparatus a second tube, fitted with a strong metallic rod, and furnished at its upper extremity with a transverse handle for rotating it, and at its opposite extremity, which should be immersed in the bottom of the cask among the calcareous carbonate, with two or more cross-pieces of metal or wood fixed at right angles with the rod. This part of the apparatus for mixing the ingredients would be the same as that contrived for a similar purpose in the well-known machine for manufacturing soda-water.

The quantities of the carbonate of lime and of the acid required for vessels of given tonnage may be deduced from the following statement, viz.:—

Four hundred pounds by weight (400 lbs.) of tolerably pure carbonate of lime, yield about one hundred and eighty pounds by weight (180 lbs.), or about twenty thousand cubic feet, or five hundred (500) tons, by measurement, of carbonic acid gas; and the admixture of about 6 ounces, by measure, of strong sulphuric acid, or 8 ounces of nitric acid, or 8 ounces of muriatic acid of the shops (diluted in about the proportion, above specified, with water for the convenience of admixture), is sufficient to neutralise about one pound of any of the calcareous carbonates, while the admixture of carbonic acid gas with atmospheric air, in any proportion not lower than one (1) part of the former to four (4) of the latter, will prevent or extinguish combustion.

The above method of extinguishing combustion was publicly verified, as far as it was possible at the time, by analogous experiment at the Sydney Mechanics' School of Arts, in 1839.

I am indebted to a talented scientific friend for the following, among several other, valuable observations:—

"It would be much better to substitute marble or limestone in small angular pieces, which would render the stirring apparatus unnecessary, and render the action less violent and more regular.

"There may be advantage in having the casks containing the lime placed beneath, but by that arrangement we neglect to avail ourselves of an important property of carbonic acid gas, viz., its great specific gravity, which causes it to descend, with almost as great facility as water, through atmospheric air, so as speedily to displace it, and to assume, or possess itself, of the lowest level.

"On this account it should be made known that the casks may be placed with equal advantage on the orlop deck, by making the requisite alterations in their construction, viz., in place of being pierced with holes, having a wide metallic tube, or leathern hose, securely fixed over a corresponding aperture in the upper end, and bent downwards, so as to be introduced within the hold. In this latter method the plan may be applicable to ships that have already received their lading."

Should the above method of applying the carbonic acid gas be required in consequence of the vessel having received its lading, or should it be adopted by choice, the gas tube or hose might be conducted with advantage into the space between the sides of the vessel and its internal lining, if not caulked, or, if caulked, provided a few apertures be left sufficiently low down to admit the gas readily into the hold.

Respecting the choice of the carbonate to be employed, the calcareous carbonates are, perhaps, as suggested, the best for the above purpose, as being the cheapest, and not liable to damage on shipboard; and of these the marble or limestone, broken into small angular fragments, as recommended in the paper quoted above, would for most purposes be the best. It would perhaps be advisable, however, that one of the casks, at least, should be provided with chalk or whiting, against cases of emergency requiring a more rapid disengagement of the gas, and that, where there is a choice, one or two of the casks should be placed as originally recommended on the kelson of the vessel, so that advantage may be taken of the expansive power of the gas, for forcing its way with as much certainty, and as little delay as possible, among a densely stowed wool cargo.

The above means of preventing or of extinguishing fire in the holds of vessels, would neither injure the vessel, the cargo, nor the provisions; nor would it, with common prudence, endanger human life. It

would of course be destructive to any live stock in the hold of the vessel; indeed, so destructive would the gas prove to all animal life within the sphere of its operation, that it might be used, in the manner above described, for the express purpose of destroying rats or insects in vessels, in place of the usual process of fumigation.

It would, perhaps, be desirable that vessels should be provided with a larger quantity of the carbonate and of the acids than the mere supposed interstidal spaces left by the cargo in the hold of the vessel might seem to require, so that provision might be made against the possible gradual escape of the gas, and any consequent tendency to a repetition of the accident before the vessel could arrive in port or discharge her cargo.

The following, however, would no doubt be a redundant supply for a vessel of 500 tons when loaded:—

Carbonate of lime (*e. g.*, marble or limestone, broken into small angular fragments, or whiting, or chalk,) 84 lbs.

Sulphuric acid, about 32 pints, or nitric acid, 42 pints, or muriatic acid, 42 pints; though the precise proportions would of course have to be determined by a consideration of the purity of the carbonate, and of the strength of the acid employed. The casks ought to be capable of containing the above ingredients, with the addition of the due proportion of water, and ought to be then of sufficient size to preclude the escape of their contents, either from the motion of the vessel, or from the effervescence of the ingredients during their admixture.

The average cost of the acids, in England, would be, perhaps, as follows:—

	£	s.	d.
The sulphuric acid, at 4*d*. per pint......	0	10	8
„ Nitric acid, at 1*s*. 6*d*. ditto	3	3	0
„ Muriatic acid, at 6*d*. ditto	0	17	6

The cost of the entire apparatus would not perhaps exceed 18*l*., or about 6*l*. each cask, with the tubes, &c., complete.

The cost of the marble or chalk would be a mere trifle, perhaps not exceeding 10*s*.

So that the entire average cost of the apparatus, and of the ingredients for a ship of 500 tons, would not exceed 21*l*.

The acids ought to be packed with much care, in small stout bottles, with glass stoppers, in a box lined with tin, and the interstices between the bottles filled with whiting. The measures for the acids should be glass, as also the funnels for pouring the acids into the tubes, &c., and of due strength,* and then if the mere precaution of adding the acids to the water and the carbonate, slowly, and with occasional pauses, be observed, there would be no more danger in the carriage, and in the use of the acids, than in those of the kabose, or of a common lamp, nor perhaps so much. Strong pyroligneous acid, or strong vinegar, might however be substituted for any of the above acids, if used with the chalk or whiting. These would be used undiluted, in the proportions of one pint of the former acid, and of about four pints of the latter acid to each pound of the carbonate. But these acids would be considerably more expensive, and the vinegar would require a greater number of casks, or casks of larger dimensions.

Description of Engraving.

The prefixed figure is a vertical section of a vessel fitted with the apparatus, placed on the kelson, without and with the stirring appendage.

AAA, kelson; BBB, deck; CCC, masts; DDD, casks; EEE, tubes or pipes for introducing the water and acids into the casks; F, handle and tube of the stirring apparatus; G, perforations for the escape of the gas.

* Packed in the box with the acids, with one or two of each to spare; the box containing the acids to be cleated down to the deck, and ready for immediate use. The funnel might be dispensed with, by means of a slight modification in the form of the upper extremity of the tubes.

MR. BABBAGE'S PET POST-BAGS IN 1831.

Sir,—It is often curious to observe the efforts which, under the sense of its being wanting, ingenious men successively make for some improvement in our mechanical arts. We now look back to the old mail coaches and high-priced letters with astonishment; and we think of the lumbering arms of the old Admiralty telegraph pretty much as we recollect a dream in which all our physical powers had been paralysed.

No one will question the ingenuity and philosophical prescience of Mr. Babbage, or even the very important *practical character* of his views, with respect to machinery and manufactures. I was, however, much astonished a short time ago, when reading his "Introductory View of the Principles of Manufactures," prefixed to Professor Barlow's "Treatise on the Manufactories and Machinery of Great Britain," in the "Encyclopædia Metropolitana," at the passages which I transcribe below. They speak for themselves, and require no comment, as showing how wide of the mark even so able a speculator as Mr. Babbage may sometimes may be. The volume is dated 1836 in the title-page; but this is the

period of its completion, and the dissertation in question is at the beginning. From a note at p. 56 it appears to have been written in 1831; and at p. 72 an extract is made from the statement of Mr. Felkin "On the State of the Bobbin-net Trade," which was itself published in the same year (1831):—

"The conveyance of letters is another instance in which the importance of saving time would allow of great expense in any new machinery for its accomplishment. There is a natural limit to the speed of horses, which even the greatest improvements in the breed, aided by an increased perfection in our public roads, can never surpass, and from which, perhaps, we are at present not very remote. When we reflect upon the great expense of time and money which the last refinements of a theory or an art usually require, it is not unreasonable to suppose the period has arrived in which the substitution of machinery for such purposes ought to be tried.

"The post-bag despatched every evening by the mail to one of our largest cities, Bristol, usually weighs less than a hundred pounds. Now, the first reflection which naturally presents itself is, that in order to transport these letters a hundred and twenty miles, a coach and apparatus weighing above thirty hundredweight is put in motion, and also conveyed in the same space.

"It is obvious, that amongst the conditions of machinery for accomplishing such an object, it would be desirable to reduce the weight of matter to be conveyed in the letters; it would also be desirable to reduce the velocity of the animal power employed, because the faster a horse is driven, the less weight he can draw. Amongst the variety of contrivances which might be imagined, we will mention one, which, although by no means free from objections, fulfils some prescribed conditions, and is not a purely theoretical speculation, since we have seen, on an extremely limited scale, some few experiments upon it.

"Let us imagine a series of high pillars erected at frequent intervals, perhaps every hundred feet, as nearly as possible in a straight line between two post towns. An iron or steel wire of some thickness must be stretched over proper supports, fixed on each of these pillars, and terminating at the end of every three or five miles, as may be found expedient, in a very strong support, by which it may be stretched. At these points a man ought to reside in a small station-house. Six narrow cylindrical tin cases, to contain the letters, might be suspended by two wheels, rolling upon this wire; these might be so constructed as to enable them to pass unimpeded by the fixed supports of the wire. An endless wire, of much smaller size, must pass over the drums, one at each end. This wire should be supported on rollers fixed to the supports of the great wire, and at a short distance below it. With this arrangement there would be the two branches of the smaller wire always accompanying the larger one; and the attendant at either station might, by turning the drum, cause these two branches of the small wire to move with great velocity in opposite directions.

"In order to convey the cylinder which contains the letters, it would only be necessary to attach it by a string, or by a catch, to either of the branches of the endless wire. Thus it would be conveyed speedily to the next station, where it would be removed by the attendant to the commencement of the next wire, and thus transmitted on.

"It is not our intention to enter into the details which this or some similar plan would require: it is sufficient to observe, that it is attended with its difficulties, but that, when they are overcome, it will present many advantages besides velocity; for if an attendant reside at each station, the additional expense of having two or three deliveries of letters every day, and even of sending expresses at any moment, will be comparatively trifling; and it is not impossible that the stretched wire may itself be available for a species of telegraphic communication yet more rapid."*

How strongly do these paragraphs force upon our minds an appreciation of *the immensity of our mechanical and social progress during the last sixteen years!* It seems, so to say, more like the rapidity of an untangible dream, or the gorgeous absurdity of an oriental romance, than the sober and positive reality of our railroads and electric telegraphs. Such are the fruits of PEACE: shall we WAR away these splendid achievements, together with the genius and energy which produced them, for the pleasure or advantage of an idle and mindless faction in the state? Oh, no!

I am, Sir, yours, &c.,

TARTAGLIA.

March 10, 1848.

* This passage is remarkable; but whatever notions Mr. Babbage might have entertained about this use of the wires, he nowhere hints at electricity—though it is difficult to conceive what notion else he could have formed.

Fig. 1.

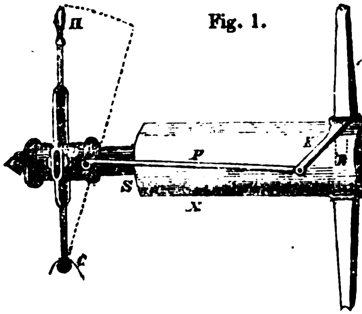
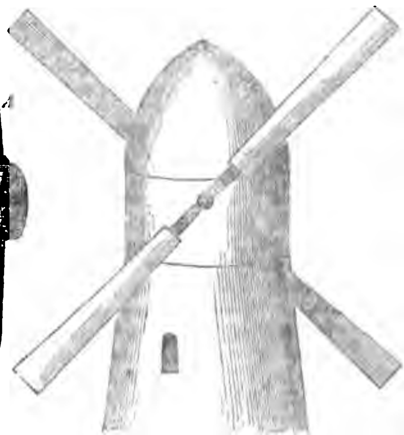


Fig. 2.



Sir,—I am surprised that we hear of improvements in windmills so seldom.* Throughout the country we find these engines still used extensively both for grinding corn and pumping water; yet these important machines appear to be capable of considerable modifications, rendering them more simple in construction and efficient in action. The improvements which at present I suggest are intended to call the attention of your more able correspondents to the subject.

Fig. 1, represents the principal parts of a windmill, with an apparatus for completely controlling the speed of its revolutions, which, in the best constructed windmills, is now generally effected by shifting the small wooden cross vanes. It will be found, I think, that, by the method I propose, the mill can be checked or accelerated in speed with very great facility, and can even be stopped almost instantaneously.

X, is the shaft; A, the arms, which are *in one piece, passing through the shaft* at R, the form being there cylindrical. The sails (not shown) are *fixed* on the arms, and may be rigid boards or sheet iron. The double arm is thus free to move upon its axis perpendicular to that of the shaft; and it will be understood, that as this arm is set at various angles, the sails will be thereby altered in position with regard to the wind. For the purpose of turning A to the required position whilst the mill is in motion, the rigid lever, K, is linked to A, and connected by the rod P to a double flanged ring or drum, D, moving on the lesser end of the shaft, and traversing it from the position represented to the point S. H, is a forked lever, carrying two friction-wheels, and having its fulcrum at C. It will be seen, that by pressing H to the right or left hand, and bringing the friction-wheels to bear on the inside of the flanges of the drum, we possess a convenient and powerful command over the arm A, to set it at any required angle with the direction of the wind, and thus to alter the motive power. If the lever, R, be free to move through a quadrant, and one extremity of the quadrant be the position of maximum effect of the wind, by bringing R into the extreme opposite position, the wind will act to turn the mill in an opposite direction, and will soon, therefore, destroy its initial motion. Intermediate positions of R will, of course, moderate the speed correspondingly.

The second suggestion is one which I suspect has occurred to others before me; yet I cannot discover why it should not be generally attended to. By having both arms of windmills at the same end of a shaft, a great strain is caused on

* The last, we believe, was that of Mr. Biddle, described in our Journal for June 6, 1846. It appeared to us to possess great merit, and we expected to have heard, before this, of its general adoption.—Ed. M. M.

the building which supports it; and to obviate this in some measure, the shaft is generally inclined from the horizontal, by which alteration much useful power is thrown away. If the arms were placed *one at each end* of the shaft, (as in fig. 2,) the whole structure would be symmetrical, the bearings pressed on equally, and, moreover, the mill-head would never require to turn *more than one quarter round* for a shift of wind, as the wind would then begin to blow first on that arm which it had before reached last.

One word to your correspondent, "Fair Play," on the subject of Doull's electro-magnetic wheel. The words in my letter were these: "It will be seen that *the magnetic attraction, when most powerful,* will be acting in the worst possible direction for the production of rotary motion." "Fair Play" has omitted to quote the words which I repeat in italics; and no wonder that his substitute for them has produced a dictum which surprises him.

I am, Sir, yours, &c.,

JOHN MACGREGOR.

24, Lincoln's-inn-fields, March 11, 1848.

ELECTRO-MAGNETIC ENGINES.

Sir,—I am one of the last men who would discourage the exercise of mechanical ingenuity, either mechanical or otherwise, and have, therefore, always been pleased to find your pages open to any suggestion or discussion calculated to improve either mechanism or science of any kind. You give every scheme, which is not perfectly absurd upon the face of it, a fair chance; and even in some cases a very close approximation to the ridiculous has been allowed. Mechanical inventions are only means of so modifying the forces of nature as to render them available for the performance of WORK—of work which, either by the velocity required, the forces to be simultaneously exerted, or the delicacy to which the human hand is incompetent, cannot be effectively and economically performed without their aid—if, indeed, it can be (as in innumerable cases it cannot be) performed at all. As we can only know from experiment what the forces of nature are, how they can be brought under our control, or what may be their intensities,—it would obviously be preposterous to affirm, *à priori*, that any proposed combination of these forces must fail to produce an assigned effect. But, on the other hand, if we are acquainted with the laws according to which those forces act (and be it remembered their action is involuntary and inevitable), we are in possession of materials for guiding our judgment, as to the *effects* which any mode of bringing those forces into play by mechanical combinations, would make manifest. Surely, then, it is *imperative* that projectors should acquaint themselves with the modifications which force must inevitably undergo when it is brought to bear upon any mechanical combination! Yet how seldom do we find this rule attended to by our "inventors" and "patentees;" and how often do we see ample fortunes wasted, and valuable lives consumed in fretful penury, by the most determined infatuation to work out schemes, which could only be successful by an abrogation of the positive laws of nature!

"'Tis true, 'tis pity—pity 'tis 'tis true."

Had it not been, however, for the article in this day's number of your Magazine, signed "Fair Play," I should scarcely have troubled you with this letter, much as I, in common with all men who wish well to our species, and especially to the inventive genius of our country, may deplore the faults to which I have adverted—faults so generally deplored that it becomes trite to speak of them. Had Mr. Doull been acquainted with the most elementary doctrines of the "resolution of forces" he must have foreseen the objection which Mr. MacGregor made to the disadvantageous action of his magnets for producing rotation. The other difficulty may *perhaps* be got over by mechanical ingenuity, though not so off-handedly as "Fair Play" would imply; but this one objection is *essentially fatal,* under the circumstances of the case. Mr. MacGregor pointed out the fallacy of Mr. Doull in the most candid and courteous manner, and deserves the thanks of Mr. Doull and his friends. What does he get in return? Simply "a pooh-poohing," as though he had written nonsense so gross that he was not worthy of a serious reply. He answers, "there could be no great difficulty" in doing so-and-so; just as if the question had been that of substituting the tongs, when the poker had leave of absence, for stirring

his study fire. Let "Fair Play" show *how* his "not very difficult" arrangement is to be formed; we shall then understand him, and shall know, too, what right he has to the signature he has adopted. *It is not fair play* to throw out random assertions in answer to any direct and tangible objection which may be made to a proposed scheme: *it is disingenuous.*

But this in not all. With respect to the objection made by Mr. MacGregor to the direction of the force being the most disadvantageous possible for accomplishing rotation about the point of contact of the wheel with the rail, "Fair Play" asks with the most *naïve* absurdity, whether Mr. MacGregor "means to say" that what is true of every single portion of the force is true of the total force! Undoubtedly he does; and so does every man else who comprehends the mere alphabet of mechanical science.

"Fair Play" has saved the flash of his squib for the tail of his letter. Like the shrapnel-shell, its destructive effects accompany its final explosion. "Perhaps," says he, "Mr. MacGregor *has too learnedly symbolised himself* into erroneous views on this subject." Thus it ever is:—men who exert themselves to instruct the uninstructed, and to diffuse a knowledge of the accurate sciences amongst the "practical" classes, are sneered at and ridiculed in the language of the workshop, with all the rudeness which ignorance and conceit know so well how to use. Like the self-willed urchin in the dame's school, who "we'ant say A 'cos he must say B," these men resist the admission of the elements of science into their minds, lest it should, perchance, destroy their "noble independence" upon themselves for the development of their *inventive faculties and practical skilfulness!* Surely, Sir, you will join heart and hand in suppressing this most rampant nuisance—a nuisance, I can venture to predict, which will, if not removed, discourage scientific men from attempting to enlighten the industrial classes upon those subjects which, *in respect of their own interests*, are of paramount importance. An effort, and evidently no small sacrifice, has been made by a band of your most able contributors (of whom Mr. MacGregor is one) to furnish to the "practical engineer" and the artisan some ideas on the *first principles* of the science of mechanical operations; but they cannot feel otherwise than disgusted with such rude attacks on their philanthropic labours, and in an evil hour they may be so far disgusted as to retire in a body from what they may be led to think a hopeless task, and an unavailing exertion for the public good.

I wish I could think this a solitary case; but there is so much evidence in the great majority of the writings of our practical men, even in your own pages, of their entertaining a supreme contempt for what they are pleased to call "theory," that it becomes necessary to point out to them the very grave mistake under which they labour as to the value of "this same thing called theory." Quite disregarding such a person as "Fair Play," I shall, with your permission, occupy hereafter a few pages in attempting to show *what theory is*, and *what functions theory performs* in the mechanic arts.

I ought to say that Mr. MacGregor and Mr. Doull are alike unknown to me personally; so that, in my notice of the writer who so fallaciously passes himself off as "Fair Play," I am guided by no personal predilections. More I need not say than subscribe myself, yours, &c.,

TARTAGLIA.

March 11, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 255.)

V.—*The Gentleman's Mathematical Companion*.—(Original Papers.)

ART. I. On certain Properties of Plane Triangles; being a Synoptical Table of *known parts* and positions, or *loci* of certain parts of a plane triangle, when certain other parts are given. By John Farey, Esq., London.

II. Geometrical Solutions of some Celebrated Problems.

Prob. 1. Given the latitude of a place, and two almicanters or circles parallel to the horizon, to find the declination of a star, which will pass from one to the other in the least time possible.

2. To find the declination of that star whose change in azimuth is a maximum or a minimum in a given time, reckoning from the time that it transits a given almicanter in a given latitude.

3. Every triangle is a mean propor-

tional between the rectangle under half the perimeter and its excess above one of the sides, and the rectangle under its excesses above the remaining sides. (*Two demonstrations.*)

4. "If Q be the point in a triangle from which perpendiculars are drawn to the sides of the triangle, so that the sum of their squares is the least possible, twice the area of the triangle is a mean proportional between the sum of the squares of the sides of the triangle, and the sum of the squares of the above-mentioned perpendiculars."

5. Three staves being erected in some certain place of the earth, perpendicular to the horizon, in the points A, B, and C; whereof that at A is 6 feet long; that at B, 18; and that at C, 8;—the line AB being 33 feet long;—it happens, on a certain day in the year, that the end of the shadow of the staff A passes through the points B and C; and of the staff B, through A and C; and of the staff C, through the point A. To find the sun's declination and the elevation of the pole, or day, and the place where this shall happen.

By James Skene, Esq., M.A., Aberdeen.

. The above paper enters very fully into the history of the problems under discussion, and was communicated to the *Companion* by Mr. Skene, under the assumed name of "Beta Cygni," as appears from vol. i., p. 347, of Leybourne's edition of the *Ladies' Diary*. The first problem, it appears, has occupied the attention of the Bernoullis and La Fontaine, and is not unknown to modern analysts. "The second," says the writer, "was first proposed in one of those annual publications which, though small in size and unpromising in their titles, have formed more mathematicians in Britain than the schools;" the third is an attempt to improve upon the demonstration contained in the "Clavis" of Oughtred; the fourth supplies a demonstration omitted by Professor Playfair in Art. 28 of his "Origin and Investigation of Porisms;"—the fifth has occupied the attention of Descartes, Schooten, and Sir Isaac Newton, who gives it as problem 55 of the *Arithmetica Universalis*, Wilder's edition, 1769. It was re-proposed as the prize question in the *Ladies' Diary* for 1744, and was solved by Mr. Anthony Thacker, who had previously suspected an error in Sir Isaac Newton's solution. The concluding remarks of Mr. Skene's paper, though written in 1804, have such an obvious bearing on some recent discussions in the *Mech. Mag.*, that they are here transcribed:—"By thus pointing out the propriety of sometimes employing the *geometrical* in preference to the *algebraical* analysis in resolving problems, it is not my intention to detract from the merits of the latter, but only to caution *against being misled* by the practice of those mathematicians who seem to have entirely deserted the paths of the ancients. *Each has its peculiar advantages.* The *ancient* geometry stands unrivalled for perspicuity and incomparable logic; but however much the mathematician may admire it, he is obliged, perhaps unwillingly, to acknowledge its inferiority to the *modern* methods, when he wishes to investigate the laws of nature, and connect together the various phenomena of the universe."

III. Solution of a very important Problem in Spherical Geometry; viz., "A sphere being given, to find its diameter, and describe a great circle thereof." By William Smith, Esq., Liverpool.

IV. Geometrical Porisms. By Mr. Mark Noble.

. This paper is alluded to by Professor Davies in his valuable "Historical Notices respecting an Ancient Problem," published in the *Mathematician* for the present month.

V. Solution of the problem—"To find three numbers in geometrical proportion, such, that if any given number (n) be added to each of them, the three sums thence arising may all be rational squares." By Mr. James Cunliffe.

VI. An Easy Way of Obtaining Theorems Expressing the Sums of Certain Infinite Series. By Mr. James Cunliffe.

VII. Investigations of some Curious Problems.

Prob. 1. To divide the sum of two squares into two other squares.

2. To find three square numbers such that the difference of every two of them may be a square.

3. Having given the tangent of any arc, to find the tangent of (n) times the arc.

4. On the method of finding trinomial factors; a subject of great importance in the calculation of fluents. By James Cunliffe.

VIII. To Find Expressions for the Sides of a Scalene Triangle in Integers, such that the Area of the Triangle may be an Integer. By James Cunliffe, Jun.
THOS. WILKINSON.

Burnley, Lancashire, March 9, 1848.

LLOYD'S, OR THE SHIP-SINKING SYSTEM.

Some thirteen or fourteen years have elapsed since a good deal of discussion took place in this Magazine on the momentous question involved in the above heading; and much about the same time it was also very ably and earnestly handled in other leading journals, especially the *Spectator* and *Examiner*. Somehow or other the agitation on the subject died quite away, and it is long since we have heard anything of it. The reason of this would appear to have been the disappearance from the scene of Mr. James Ballingall, the great hero of that agitation. We long thought that he had departed this life, or been rendered, by some mysterious visitation, as good as dead to the cause. Very glad we now are to learn—for the cause's sake as well as Mr. Ballingall's—that he is still alive, and has only removed himself to another, though far distant sphere, where he is once more honourably exerting himself to make his voice heard in behalf of the multitudes who "go down to the sea in ships," and who are now annually sacrificed in thousands to the "ship-sinking system" of Lloyd's. The last papers received from Melbourne, Port Philip, contain an account of a public meeting which has been held of the inhabitants of that settlement, (Ald. W. M. Bell in the chair,) when a very long and interesting report on the frequency of shipwrecks was laid before them from the "Port Philip Immigration and Shipwreck Society," of which Mr. Ballingall is honorary secretary. The report was unanimously adopted by the meeting, and ordered to be printed for universal distribution. The Report dwells, in the first place, on the two most prominent defects of the mercantile navy, namely, that the ships are allowed to be so weakly built, as to incur almost a certainty of shipwreck under circumstances which would involve no danger to better constructed vessels; and that they are also permitted to be so incompetently commanded and officered, as to suffer shipwreck under difficulties requiring only the most ordinary skill and seamanship to overcome them. These facts are illustrated by the following recent cases:—

CASE NO. I.

The ship *Regular*, from London to Bombay, on the 13th of May, 1843, carrying a valuable cargo of specie and metals, when off the Cape of Good Hope sprung a leak without coming into contact with any solid body, and went down in the open sea, being 900 miles from any land. The persons on board, numbering 34, were in this instance providentially saved in the boats. This ship had lately been restored to the first description of the first class of Lloyd's.

CASE NO. II.

In May, 1845, the ship *Mary*, from Sydney to London, struck on a rock near Flinders' Island, in Bass' Straits, and in seven minutes from the time she struck the ship was in pieces, and seventeen persons drowned. The captain was below, unaware of the danger, when it occurred.

CASE NO. III.

In August, 1845, the *Cataraqui* ran on a reef of rocks off King's Island, in Bass' Straits, and in half an hour from the time of her striking all the passengers below were drowned. Immediately on striking she was sounded, and found to have made four feet of water in her hold. The *Cataraqui* was nearly a new ship, and by this catastrophe 399 emigrants and crew were drowned. It is reported that this frightful disaster occurred solely from the lamentable ignorance of the master of the vessel respecting his position.

CASE NO. IV.

In March, 1846, the *Maria Somes* left Ceylon, with 318 soldiers, 90th regiment; soon afterwards the ship, encountering bad weather, sprung a leak, and made five feet of water. The hatches were battened down—and on opening them, thirteen persons were found dead, from suffocation. The *Maria Somes* was nearly a new ship.

CASE NO. V.

In April, 1846, the *Heroine*, Captain Mackenzie, left Sydney, and ran on a sunken rock in Torres Straits, and went down *instanter*, so that there was not time even to lower the boats. In her eight persons were drowned.

CASE NO. VI.

In July, 1846, the *Eweretta*, from Sydney, with a cargo, valued at 25,000*l*., in going up the Thames got upon her own anchor, and soon afterwards went down, in

the London Docks, so suddenly, that the persons on board had barely time to reach the quay in their night-clothes, before she sank.

CASE NO. VII.

In March, 1847, the *Sovereign*, steamer, coming out of Moreton Bay, New South Wales, in crossing the bar, without striking the ground, got disabled, and in three quarters of an hour afterwards sank, with all on board.

The Report then urges the necessity of making merchant vessels of the same build and strength as men-of-war; and, adverting next to the modern "Lloyd's Register," proceeds as follows:—

Your committee will now endeavour to exhibit something of the system under which merchant shipping are, at present, built and conducted:—A society was formed in 1834, (*vide* "M'Culloch's Dictionary," p. 1114,) under the superintendence of a committee, in London, of twenty-four members, composed of an equal number of merchants, shipowners, and underwriters, for the purpose of making a new classification of merchant shipping; and with their name and authority is annually published the elaborate work called "Lloyd's Register of British and Foreign Shipping." The rules of this society for the construction of vessels govern the shipbuilder, and its register of classification is the guide-book for the shipowner, the underwriter, the merchant, and the public. Now, it is affirmed that these rules define, for the highest class of ships, a specific construction, incomparably inferior to that of the vessels of the Royal Navy, and such as to render merchant ships incompetent to cope, like those of the Royal Navy, without wreck, with casualties at sea.—*Vide* the Rules of "Lloyd's Register of British and Foreign Shipping."

Having used some research in discovering wherefore such rules should have been made, and obstinately adhered to, we will point out the result of our labours:—

First.—The highest class, or strongest ship, and that upon which the smallest premium of insurance is taken, is so defective, as to require one-tenth more money to be laid out on her, to make her *really seaworthy*.* But as an equal premium would be charged on the ship so made seaworthy, the underwriters, hereby, so far make it the interest of shipowners not to possess seaworthy ships.

Second.—Underwriters pay only two-thirds of damage, in case of a partial loss, but pay in full, if the vessel be totally lost. Hence the anxiety by the shipowner for the possession of such a vessel as, in case of an accident at sea, would sink *instanter!*

And for evidence that *unseaworthiness is not a bar to the recovery of insurance*, and that no hazard is too great for the underwriters, take the following extract from "M'Culloch's Dictionary," pp. 714 and 715:—"It might be supposed, at first sight, that insurance affords a much less perfect security than it really does, seeing on how many pleas it is possible for the insurer to dispute his liability; but when it is considered that the proof of unseaworthiness is thrown upon *him*, the insurer, and that the leaning of the courts is always in favour of the insured, it will be easy to suppose that no respectable insurers will ever plead unseaworthiness, unless they could make out a case of more than ordinary strength and clearness. The degree of uneasiness felt by merchants and shipowners, at their liability to be involved in loss, by cases of unseaworthiness, may be gussed from the fact that, although the Indemnity Assurance Company, at one time, precluded themselves from pleading unseaworthiness, by a special clause in their policy, not only did they obtain no additional premium, in consequence thereof, but they did not even obtain a preference over other companies and individuals at the same premium. Unseaworthiness may be caused in various ways, such as want of repair, want of stores, want of provisions, want of nautical instruments, *insufficiency of hands to navigate the vessel, or incompetency of the master*."

In endeavouring to account for practices, inducing the building of unsafe vessels, we were led to suspect that a combination existed between the shipowner, underwriter, and merchant, for this purpose, and accordingly we find that the committee of Lloyd's consists, as we have before stated, of an equal number of merchants, shipowners, and underwriters, who regulate the construction and classification of merchant shipping; and further, we find (from "M'Culloch's Dictionary," p. 713,) that "one-half of the underwriters in London is composed of seven companies, who number amongst them some of the most eminent merchants and shipowners." Hence it follows, that similar interests govern the insured and the insurer, in classifying as well as in building ships for insurance, and the underwriter and shipbuilder work together on this wise. The shipbuilder constructs weak ships in order to increase his trade, and that the public may insure, and put money into the pocket

* "Safe to navigate the ocean," might be a better expression than "seaworthy." No person can define what "seaworthiness" is.

of the underwriter. The merchant is quieted by being taken in as a partner with the underwriter; the shipowner, being insured, suffers no loss by the loss of his vessel, and hence is concocted, wheel within wheel, the infernal plot, which, carried into effect, yearly destroys, as before quoted, nearly two-and-a-half millions of property, and consigns nearly fifteen hundred human souls unwarned and unanealed to their last account.

To show one effect of, and encouragement to this crime, we exhibit the following particulars ("M'Culloch's Dictionary," p. 1112):

"Some ships are so very bad, that they actually go to pieces on their first voyage; others *with difficulty* last but three, four, or seven years; and others, again, run for ten, fifteen, and even twenty years, and upwards, with but little repairs."

After this extract, we are more than justified in stating, that a really *seaworthy*-built ship will, irrespective of all its other superiorities, last *twice as long* as one of ordinary build.

Finally.—Your committee would draw attention to the facts elicited in this report bearing directly upon the evils—to obtain the correction of which is the object and aim of this society.

The fact of unseaworthiness is allowed by the shipowner and underwriter to arise from incompetency of the master and insufficiency of the crew, as well as from want of repairs to the vessel, &c.; and yet unseaworthiness is never made a bar to the recovery of insurance. So that not only no encouragement is given by the underwriters for shipowners to possess sound ships, and really able masters and seamen; but the committee of Lloyd's define for the highest class of vessels a defective construction. And, besides this, the underwriters encourage to the last degree the employment of deficient masters and crew, and of defective vessels, and offer a premium upon total wrecks and wholesale murder, by their custom of paying the full insurance upon a total loss, and only two-thirds of the amount of damage in the case of a partial loss!

The Report winds up with the following energetic appeal to the authorities at home:—

We trust that the government will not much longer permit the enormities of a system, by which the cupidity of a body of men is allowed to pursue its wretched cravings, not only at the sacrifice of an immense capital, which is repaid in additional charges for freights—thereby imposing a tax upon the community, and a check upon the commerce of the country—but at the expense also of the lives of so many of our hapless fellow-subjects.

Your committee will at present rest in their report, with the hope that an *earnest inquiry* will ere long be set on foot in the proper place, into this great public grievance, and in the mean time they recommend that every available method be taken by the society for the diffusion of its views, and the general adoption of its objects.

Your committee will now merely take leave to add, that they can see no method so readily available as that of getting a proper plan of construction, proportioned to the size and capacity of vessels, but having no reference to their form or shape, prepared by the surveyor and master shipwrights of the Royal Navy, (who can only have an interest for the public good,) to be approved by the proper authorities; and that surveyors in the pay of, and responsible to, government, be appointed to see that this construction is adopted and faithfully carried into effect, and that the vessels are kept subsequently in good repair: these rules to be enforced by the condition of obtaining a register in the first instance, and a clearance from any port in the British empire in the second. And further, that proper boards be appointed by the government for the examination of the qualifications of masters and mates in the merchant service; and with power to investigate into the cause of loss of all vessels wrecked: these suggestions to be embodied in an act of parliament.

THE CANTELONIAN SYSTEM OF HYDRO-INCUBATION.

[Patent dated February 25, 1846.]

The hen has only two broods a-year, sitting on perhaps twenty to twenty-six eggs, and rarely bringing to *marketable fowls* more than fifteen or sixteen. The hydro-incubator has eighteen broods in the year, and out of 1,800 eggs (100 eggs being the contents of the smallest size) will produce 1,500 *marketable fowls*, from 2½ to 3½ lbs. weight. A calf takes four to five years to fatten up to 12 cwts.; now 600 chickens can be raised to 15 and 18 cwts. in 96 days—giving an immense advantage to the poorer class of farmers, as he turns his money from sixteen to twenty times. Mr. Cantelo's physiological discoveries consist in finding the exact blood-heat of the feathered tribe in general to be at 106°, instead of 98°, Fahr., as hitherto supposed; and that, during the process of incubation, the egg is submitted to two distinct temperatures—viz.: that of the hen's breast, which is in immediate contact with the germ of the egg, and the other parts of the eggs which are of about the temperature of the surrounding atmosphere.

The English nation pays annual duty

upon 70,000,000 to 90,000,000 of eggs, and 8,000,000, or 10,000,000 of poultry may be supposed as coming from Normandy and Belgium; now, with a very little care, all all this large sum of money, paid to foreigners, might just as well be kept in our own farmers' pockets; for, although the British lion might be at first somewhat clumsy, yet he would soon vie with the French cock.

From calculations that we have seen, founded upon the experience of some years, and upon small trials, any amount of capital employed would produce a return of 60 to 75 per cent. annual profit, as the rearing of poultry is now reduced to mathematical calculation—and one really can "count one's chickens before they are hatched!" We certainly must all admit, that it is not a taste to create, but a want to gratify, as the public would certainly eat poultry if the price were as low as butcher's meat. Supposing each person in the United Kingdom to eat only one fowl a month, we have the enormous amount of 336,000,000 of poultry, of which not 10,000,000 are at present supplied, thus leaving an immense field open to the capitalist. The guano and feathers would about pay one-half the expense of labour. We understand that the Zoological Society has requested some emu's eggs to be submitted to the Cantelonian process of hydro-incubation, and that five have already been sent from the gardens. These eggs are of a light sap green colour, closely covered with coruscations of a dark sap green; they weigh from 17 to 18½ ounces, and measure about 13¾ to 10¼ inches, both circumferences.—*Mining Journal.*

LIGHT'S WATERPROOF RUSH BUOYS.

[Patent dated July 19, 1847. Patentee, Edward Light, of Bermondsey. Specification enrolled January 19, 1848.]

The patentee states, that when rushes and such-like plants have before been employed in constructing buoyant apparatus for various purposes, it has been usual to place the rushes in cases, such cases being rendered waterproof, the rushes giving substance and strength to the article so formed, and yet for the bulk occupied the rushes have offered very little weight. Such apparatus, though useful so long as the external cases are perfectly resisting to the passage of water into the interior, are of comparatively little value when water penetrates the exterior covering, so as more or less to saturate the rushes or similar plants employed. The present invention consists in rendering the ends and the exterior surfaces of the rushes, flags, and other such plants, waterproof, before placing them into cases, according to the nature of the buoyant apparatus to be made therefrom, so that an apparatus padded or filled with rushes or such-like plants, according to this invention, will not be liable to have the rushes or other plants employed, saturated with water, when the exterior covering applied, no longer resists the passage of water into the interior of the apparatus, because each portion of a rush used will itself, at its outer surfaces, be waterproof, and thus prevent the passage of water into the cellular or pithy interior, by which means each piece of rush, or similar plant used, will be a waterproof instrument.

In carrying out this invention, any waterproof varnish, or composition, may be employed for sealing the ends, and coating the exterior surfaces of the rushes, or other plants to be employed. As heretofore, the form of the buoyant apparatus may be various, and the shape itself forms no part of this invention. But whatever be the shape of the case to be employed, the rushes, or other similar pithy plants, must be cut into such lengths as to pack closely together into the form desired, and the ends of each piece dipped into the waterproof varnish, or composition, which is to be employed, and allowed to dry; the process is repeated till the ends are well sealed and closed. The exterior surfaces of the rushes or plants are coated with waterproof varnish, or composition, and when dry are made up into cases of such shapes or forms as may be desired, the patentee preferring to use waterproof fabrics for the external casings of the buoyant articles.

STEVENS' GELATINOUS COMPOUNDS.

[Patent dated May 29, 1847. Patentee, Alfred Stevens, of Queen's Terrace, St. John's Wood, chemist. Specification enrolled November 29, 1848.]

This invention consists in certain methods of treating calves' feet, "cow heel," "sheep's trotters," and other substances of a similar kind, possessing gelatinous and edible properties, for the purpose of producing dry preparations or powders, which may be employed for expeditiously making jelly, blanc-mange, lozenges, and similar gelatinous compounds.

The preparation or powder for making jelly is produced in the following manner:—"The calves' feet or similar substances are put into a pot or boiler, and just covered with water; the pot is then placed over a fire, and the contents caused to boil until the glutinous properties of the aforesaid substances are entirely extracted, which will generally be effected in six or seven hours,—the degree of heat applied not being allowed to exceed the usual boiling point, and care being taken to skim off any oily matter that may rise to the top. The glutinous liquor is strained into any suitable

vessel, and allowed to remain until cold; it is then clarified by the addition, to every twelve gallons of the liquor, of the white of from one hundred to two hundred eggs (according to quality, as the patentee sometimes finds one hundred to be sufficient, and at other times two hundred are required), and three or four ounces of lemon juice, or one ounce of acetic acid or pyroligneous acid, or one ounce of citric acid in a dry state (any other acid of an innocuous character will answer); and a further addition is made of about four pounds of lemon peel. The mixture being now passed through a bag or sieve, a bright jelly is obtained; and if this jelly be too thin, it is evaporated by means of a water-bath, until sufficiently thick to pour out dry. The jelly or preparation is now placed in a drying oven, in which it is subjected to a heat of 100° Fahr., for a period varying from three to seven days; it is then reduced to powder by first pounding it in a mortar and afterwards grinding. Twenty pounds of this powder are mixed with thirty-four pounds of pounded loaf sugar, and as much more acid in a dry state as may be required; and the mixture is placed in bottles untis required for use. Six or seven ounces of this powder or preparation (according to the temperature of the atmosphere) with three or four glasses of white wine, and a pint-and-a-half of boiling water, will make a quart of jelly."

The following is the method of producing the preparation or powder for making blanc-mange:—"The calves' feet or similar substances are boiled down, as before described; then the liquor is clarified by the addition, to every twelve gallons of it, of the white of thirty eggs, without any acid, and but a small quantity of lemon peel; and the flavour of almonds is given to the liquor by the introduction of almond water, made by pounding blanched almonds in a mortar,—about twelve ounces of bitter almonds and twenty-four ounces of sweet almonds being used for every twelve gallons of the glutinous liquor. The glutinous preparation is then dried in an oven, and reduced to powder; after which it is mixed with an equal weight of pounded loaf sugar, and with some essence of almonds, or other flavouring material, if desired; and it is then bottled. Four ounces and a half of this preparation, with a quart of boiling milk, will make a quart of blanc-mange."

The preparation for making lozenges is obtained by boiling down the calves' feet or similar substances, and evaporating the glutinous liquor to a proper consistency; then adding flavouring materials, such as are commonly used by lozenge makers, and finely pounded loaf sugar. This preparation may be made into lozenges in the ordinary way.

NOTES AND NOTICES.

White Paint from Antimony.—At the last monthly meeting of the Liverpool Polytechnic Society, Mr. J. A. Forrest read a paper "On a new mode of manufacturing white paint." He suggests that an excellent body paint, superior to that manufactured from lead, may be made from the white oxide of antimony. It has many advantages. He has ascertained, that though antimony is now high in price, were there a demand for it it could be obtained in abundance at about 12*l.* a ton, whereas the lead used costs 24*l.* 10*s.* The new paint would consequently be much cheaper; it is, besides, not so apt to lose its colour, and will spread over a much larger surface than an equal weight of the paint manufactured from lead.

Transmission of Money by Railway.—Mr. Chubb has invented an iron box for the transmission of money, bullion, &c., on railways. A wrought-iron box, lined throughout with hard steel plates, is locked down at the terminus to a strong iron plate in the guard's carriage; the key of this lock, and also the key by which access can alone be obtained to the interior, is kept at the principal terminus by the officer who has charge of the cash. Each station-master is provided with a key, which opens a small lid at the top; when he has money to send, he unlocks the lid, places his bag of money or parcel in an open drum underneath, moves a handle which turns the drum, and the cash is dropped inside: before he is able to take out his key, he must move the drum back, and see that the money is gone. It will be observed, that he cannot leave the lid unlocked: when the box arrives at the terminus it is unlocked from the frame, taken into the office, and placed on a similar frame there. The cash-keeper only can with his key then get access to the money.

Quadruple (Steam Engine) Alliance.—Messrs. A. and A. Shaw, of Park-mills, Shaw, near Oldham, have just started four new and powerful steam engines, made by Messrs. E. and J. Taylor, of Marsden, near Huddersfield. The chief point of interest connected with them, arises from their all being united together in one engine-house—a thing never before witnessed in this country. The whole power of the four engines is concentrated at one point, and works so that two cranks are up and two down, thus obviating the hitherto existing weakness of the ordinary engines, where the desideratum is supplied by the momentum of the fly-wheel. Their first trial, combined in this manner, was looked forward to with some anxiety; and at the time appointed for starting, a large number of spectators assembled to witness their first efforts. At a given signal the steam was turned on, and the whole moved together in the most perfect unanimity, eliciting marks of approbation, and affording conclusive evidence of the complete success of this "quadruple alliance," where uniform motion is indispensable.—*Leeds Mercury.*

The Atmospheric Railway System—Continued Failures on the South Devon Railway.—Notwithstanding the repeated statements of the complete success which has attended the working of the atmospheric system on this line, as made by two provincial journals—evidently the organs of the engineers—it is clear that the longitudinal valve, with its accompanying sealing material, can never be relied on for regular railway transit. The failures which are constantly occurring are, as much as possible, glossed over, and kept from the press and the knowledge of the public; but such failures do continually occur; and the constant attendance of a locomotive engine in readiness on the line, for the purpose of propelling the trains when the vacuum cannot be kept up, proves that the promoters themselves have no faith in their own system, but are determined as long as possible to throw dust in the eyes of the shareholders, and bolster up the principle to the last. We have been informed (whether true or false, we leave to the parties interested to explain,) that, during a dry and windy day, a short time since, above twenty men were

employed in keeping the valve in a situation to seal—the dust blowing on to the grease, rendering its surface dry, and absolutely useless, without such attendance. We have before us numerous dates when the train has been propelled by locomotives—the monstrous stationary engines blowing their hardest all the time to obtain a vacuum—thus employing two systems to do the work of one; and, a Sunday or two since, a train was propelled by the men in the company's employ, pushing it along at the rate of half a mile per hour. These things must be explained to the satisfaction of those who have put their faith in the system, and shown it by investing their capital in the undertaking. We believe the system of atmospheric propulsion to be mechanically sound in principle, and much honour is due to the inventor of even the valve principle; but it is evident it is not calculated for practical working.—*Mining Journal.*

A New Locomotive, called "Lablache," in honour of the great buffo, and constructed by Messrs. Wilson, of Leeds, has already been performing some very remarkable feats on the Midland. We have been assured, on excellent engineering authority, that it has been running between Rugby and Leicester, with three carriages, at an average speed of 75 miles per hour. The same engine has taken a load of 400 tons at an average speed of 30 miles per hour, which is even a still more remarkable feat. It runs upon only four wheels, each of 7 feet diameter; and its motion is described as being remarkably easy and smooth. The wheels are 16 feet apart, and were at first hung on India-rubber springs. It was built as an experiment, and its success has been so signal that the Midland have not only been tempted to purchase it, but to order others of a like character.—*Scottish Railway Gaz.*

The Broad Gauge.—The *Railway Record* calculates that the Great Western Company have, in the prosecution of their broad gauge conquests—the most wanton and absurd of all conquests ever entered upon—saddled themselves with guarantees to the enormous extent of £16,000,000 on a paid-up capital of only £6,000,000

Fountain Barometer.—Where there happens to be a fall of water—no matter how short the fall—notice the air bubbles which rise and float on the surface of the pool into which the water descends. Draw imaginary circles, say at the distance of 1, 3, and 6 feet from the jet. If the air is heavy and dry, as in fine weather, the bubbles will vanish almost as soon as they are formed, or only reach as far as 1. Previous to rain, or when the weather is showery and unsettled, they will remain a little longer, and probably extend to 3; whilst before very wet and stormy weather they will continue to float for a considerable time, and if not broke and dispersed by a sudden gust of wind, will reach the farthest point before they burst.

A Rare Shot.—Commander Mackinnon, in his "Steam Warfare on the Parana," mentions the following almost incredible instance of a shot passing through *both* of the paddle-wheels of his vessel without touching any part of either:—"It struck the paddle-box on the enemy's side, three or four feet above the shaft, went clean through the wheel without touching any part of it, and then passed across the deck and through the other paddle-box, not above eighteen inches from the shaft, still not touching a single blade, or any portion of the paddles. At the rate the wheels were revolving (about seventeen times a minute), it appeared quite impossible to fire a pistol-ball through without striking some part of them; and yet this 18 lb. shot had gone through both wheels, leaving no mark but the hole at entering on one side and departing on the other."

The Coming Comet.—"Astra." The period of this comet is 291·966 years. Its two last recorded appearances were on July 17, 1264, (O. S.,) and April 22, 1556, (O. S.)

WEEKLY LIST OF NEW ENGLISH PATENTS.

Henry Bashard Hobsell, of the city of Oxford, goldsmith, for improvements in studs and buttons. March 9; six months.

George Coode, of Haydock Park, Lancashire, for an improved method or methods of distributing over land liquids and substances in a liquid or fluent state, and certain improved apparatus and machinery employed therein. March 11; six months.

John Ashbury, of Openshaw, near Manchester, for certain improvements in the construction and manufacture of wheels for use upon railways and common roads, and in the methods of preparing and constructing the tyres used thereon. March 11; six months.

Alexander Alliott, of Lenton Works, Nottingham, bleacher, for improvements in spring apparatus and in balances, also in breaks, and in the means of working breaks. March 14; six months.

James Porritt, of Edenfield, Lancashire, for certain improvements in carding-engines for carding wool and other fibrous substances. March 14; six months.

Frederick William Michael Collins and Alfred Reynolds, both of Charterhouse-square, Middlesex, engravers and printers, for improvements in the art of ornamenting china, earthenware, and glass. March 14; six months.

John Hosmer, of New Cross, Surrey, surveyor, for improvements in apparatus for supplying water and for cleaning drains and sewers. March 16; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Mar. 10	1383	Edward Colsell Rose	Great Guildford-street, Southwark	Radial ring for the galleries of gas, oil, and other burners.
14	1384	Richard Pyne	Kennington Cross	Ventilating and smoke-preventing apparatus.
15	1385	William Jeakes	Great Russell-street, Bloomsbury	Day's universal simplex windguard and ventilator.
,,	1386	William Jeakes	Great Russell-street, Bloomsbury	Day's universal simplex windguard and ventilator.
,,	1387	William Jeakes	Great Russell-street, Bloomsbury	Day's universal simplex windguard and ventilator.

CONTENTS OF THIS NUMBER.

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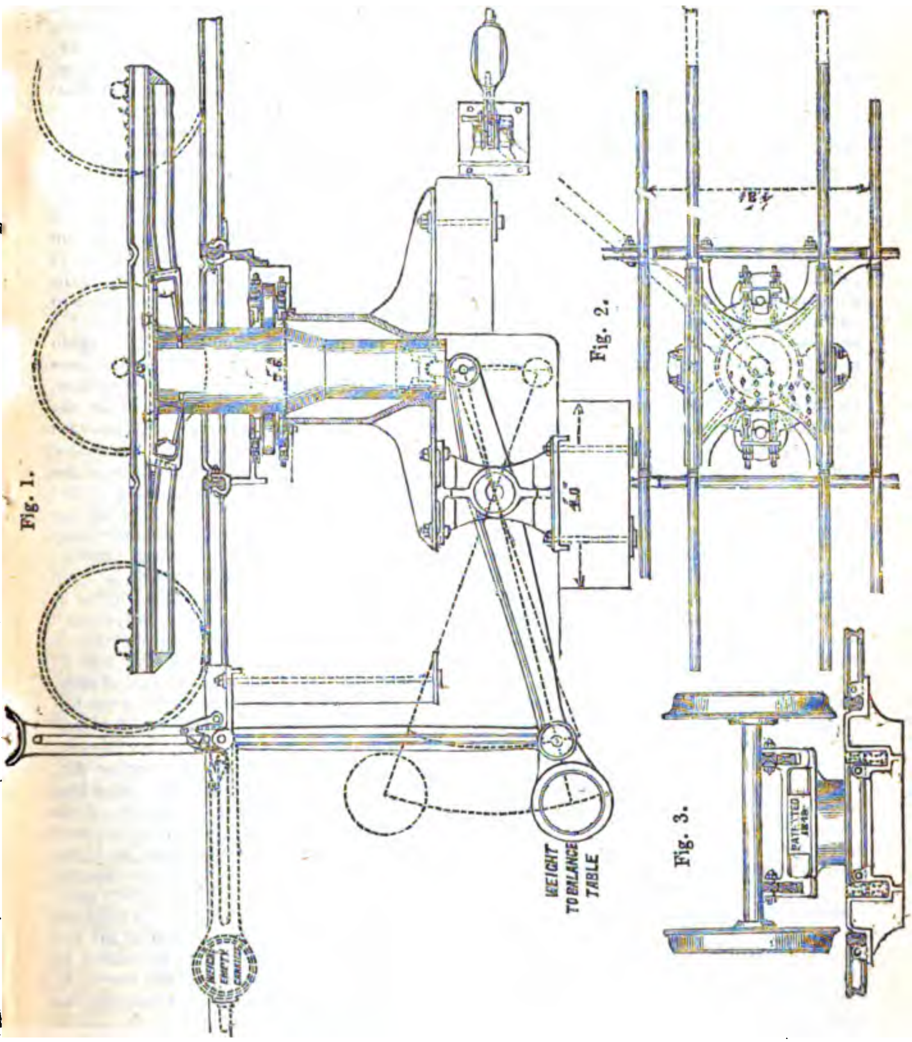
MR. MADIGAN'S IMPROVED TURN-TABLES.



MR. MADIGAN'S IMPROVED TURN-TABLES.

[Patent dated September 2, 1847. Specification enrolled March 2, 1848.

The specification of this patent embraces five different sorts of turn-tables. We select, at present, the most remarkable of these for description. It is a table which is so constructed, that, while it is capable of transferring carriages from one line of rail to another line of rail crossing the same, it leaves both the main lines of rails unbroken and uninterrupted, instead of the main lines of rail being, as usual, continued along the table itself. We have never before seen any table which could accomplish this unquestionably great desideratum:

Fig. 1 is a sectional elevation of a turn-table constructed on this plan; fig. 2 is a plan of the same; and fig. 3 an end elevation of the above-ground works, showing the position which will be occupied by the carriage while being turned round. AA is a central post, which supports at its upper end a strong cap or frame, BB, upon which, and attached thereto, are laid two strong longitudinal bars or rails, CC, which are further strengthened by struts, DD, so that the bars or rails, CC, may have sufficient strength to bear the weight of any engine, carriage, or truck, &c. which may be placed upon them, as afterwards explained. This post, A, is kept in a vertical position by means of a hollow cylindrical casing, E, within which it is placed. The position occupied by the casing, E, is central to both lines of railway, FF and F'F', and it is securely fixed to some solid foundation either of wood or masonry. G is a lever, which has its central bearing in a pedestal, H, which is also secured to some solid foundation below, while its upper end is firmly bolted to the basement of the cylindrical casing, E. The shorter arm of the lever, G, terminates in a stud, I, which takes into a hollow recess in the bottom of the pillar, A, while the longer arm of the lever terminates in a weight, H', which, together with the other parts connected to the same end of the lever, forms a counterpoise to the weight of the central column A, and the table affixed to it. K is a rod, which, at the bottom, is connected to the lever G, and at top is jointed to a lever, L, by means of a cross pin, M, which is passed through a long slot, N, in the lever, L. The pin M terminates at each end in handles, M'M', by which it may be laid hold of, so that the lever G, the central column A, and the table affixed to the cap B, may all, by the simple application of the hand, be raised through a certain portion of the limits of their range of action, for the purposes to be presently described. The lever, L, is jointed at its lower end to a fixed plate nearly on the level of the rails, while the upper and free end terminates in a weighted handle, O, which is calculated, with the leverage obtained by the machine, to form a counterpoise to the medium of the weights put upon the table. The manner of using this table is as follows:—Supposing that the carriage is upon the line of rail FF, (fig. 2,) it is brought over the place occupied by the table, which is supposed, at that instant of time, to be at its lowest position, namely, with the top of the bars or rails, CC, flush with the top of the line of rails, F'F'. The attendant now takes hold of the handles M'M', and presses them downward, which is easily accomplished, with the assistance of the counterpoise, H'; and by this action the central column is raised up, and brings the rails CC in contact with the axles of the carriage. A catch, P, which is attached to the lever L, is now brought down upon the cross pin M, which secures it from again sliding up the slot, N, until it has been released on the completion of the operation. The lever, L, is next laid hold of by the attendant, and brought down to the position it is represented as occupying by the dotted lines, which causes an additional rise of the table and its load, and the wheels of the carriage to be taken thereby clear off the rails. The table and carriage are now ready for being turned to the required position over the line of rails, F'F', which is again easily accomplished by hand (the friction of the rubbing parts being comparatively small), and by a reverse operation the carriage is lowered upon the rails, and the table into its original position, flush with the line of rails. RR are friction rollers, fitted upon the top of the hollow casing, E, to facilitate the horizontal movements of the table.

As, in consequence of the varying diameter of the carriage wheels, the connecting rod, K, may not always be exactly of the length requisite to bring the top of the bars of the table, CC, in contact with the lower sides of the carriage axles, at the precise moment when the catch, P, comes into play, in order to provide against this contingency there is attached to the upper end of the rod K a sliding-piece, Y, fig. 3, by means of which, with the assistance of the screw, Z, the connecting rod may be elongated or shortened at pleasure.

One of the great advantages attending a turn-table of the kind just described, is, that trains, in passing over it, do not

touch it, and that it is consequently spared much of the tear and wear to which other tables are exposed.

Another prominent advantage is, that as the table is contained within the lines of rail, it will turn carriages on railways where tables of the ordinary sizes, such as tables of thirteen, or fifteen, or sixteen feet diameter, could not be used, owing to the contiguity of the rails; and, consequently, with this improved table six-wheeled engines and carriages may be turned with as much facility as those with four wheels.

THE LAW OF ATMOSPHERIC RESISTANCE.

Sir,—Some time before I concluded on sending you the first essay, on the subject of atmospheric resistance, (see p. 198, current vol.) I had already made some progress in writing out the demonstration of the formulæ there given. It was originally my intention to have entered into a full detail of all particulars relating to the subject, including a history of my own proceedings from the commencement: it soon became evident, however, that, on the scale on which I was proceeding, it would be a work involving an expenditure of time and trouble which I could not conveniently afford to bestow upon it. There being, therefore, no early prospect of completing the essay, according to the original design, I have latterly come to a resolution to write out the demonstration in the most concise manner possible—omitting all details not absolutely necessary to render the principles of it clearly intelligible.

This being the object and intention of the present essay, I shall only further premise, that it has long been a favourite opinion with myself, that to place the theory of the resistance of atmospheric air on a proper foundation, the only satisfactory mode of proceeding would be, to compare the results of experiments carefully made with pneumatic apparatus, with the resistance of atmospheric air, as determined also by experiment.

In my investigations on this subject I have always avoided using algebraic symbols, as far as convenience would permit, choosing rather to operate with actual numbers, representing with sufficient accuracy the average pressure, density, &c. of the atmosphere. I now proceed on the same plan, adopting the same numbers, &c. as in the first essay, viz., the pressure of the atmosphere = 14·7279 lbs. per square inch, and its height (supposing it to be of equal density throughout) = 27·864·7 feet. Also v = velocity of the plane in feet per second, and consequently the height due to the velocity, or

$$h=\left(\frac{v}{8{\cdot}0247}\right)^2.$$

When a body moves through the atmosphere, it apparently experiences only *one* pressure, yet, in reality, there are *two* separate pressures operating upon it at the same time, or, rather, the total pressure or resistance is divisible into two; viz., the pressure which arises from its striking the particles of air in front of it, which may be called, for the sake of distinction, the *positive* pressure; and the pressure arising from the partial vacuum formed behind the body, which may be called the *negative* pressure.

In the present essay, I propose to represent the positive pressure, in lbs. per square inch, by the letter p, and the negative pressure in like manner by the sign $\overline{p}$.

Let it be required to find the positive pressure, p, which a plane meets with in moving against the atmosphere in a line perpendicular to its surface, the velocity being v. Here the solution will be the same as that of the following case, viz.: —To what degree of pressure per square inch must the receiver of the pneumatic apparatus, called a condenser, be charged, so that, an aperture being opened into it, the air will issue with the velocity v? Because the air moving with the velocity v, will move with the same velocity as the plane, and, consequently, with the same velocity as the air before the plane, will have to move with, in order to make its escape. The pressure necessary to produce the velocity v in the air, will be the same in one case as in the other, and therefore the pressure per square inch inside the receiver will be the same as that which the plane meets with. Now, in the case of the condenser, the answer is given by the formula

$$p=\frac{14{\cdot}7279\times\overline{27{,}864{\cdot}7+h}}{27{,}864{\cdot}7}-14{\cdot}7279\ \ldots\ldots\ldots\ldots\ (1).$$

Which formula results from the following proportion, viz. ∴ the height of the atmosphere : its pressure : : the height of the atmosphere + the height due to the velocity : a fourth quantity, which is the pressure of the atmosphere + the pressure due to the velocity; or

$$\therefore 27{,}864\cdot7 : 14\cdot7279 :: 27{,}864\cdot7+h : \frac{14\cdot7279\times27{,}864\cdot7+h}{27{,}864\cdot7}=m.$$

or $p=m-14\cdot7279$.

And this solution agrees with experiment with quite as much accuracy as might be expected from the nature of the subject. But here it will be observed, that the air inside the receiver will be, of necessity, more or less compressed, and, consequently, be more dense than the external atmosphere. For the sake of distinction, I shall in future call the *pressure* inside the receiver, or that pressure which causes the motion of the air, plus the pressure of the atmosphere, the *initial* pressure; and the *density* of the air inside of the receiver, or the density of the air in its compressed state, the *initial density*.

The air, in passing out at the aperture, will, of course, expand until its density is the same as that of the external atmosphere. When it has arrived at its utmost state of expansion, I propose to call its pressure the *final* pressure, and its density the *final* density. On reviewing the theory on which the above formula is built, we shall see that it supposes that the air is *inelastic*, its density being the *final* density: and on this supposition, as I have before remarked, the theory and experiment are found to agree with sufficient accuracy. So far, therefore, it *would seem*, at first sight, that the *initial* density of the air has no influence on the resistance; but we shall see, shortly, that this is not strictly correct.

The necessity of this distinction between the *initial* and *final* densities of the air, will be more apparent in the case of the negative pressure; to the consideration of which I now proceed.

Let it be required to find the negative pressure, $\overline{p}$, which a plane meets with from the atmosphere at the velocity v. Here the solution will be the same as that of the following case, viz.:—To what degree of pressure per square inch must the receiver of an air-pump be exhausted, so that an aperture being opened into the receiver, the air will flow into it, in its *rarefied state*, with the velocity v? Because the air, in its *rarefied state*, will move with the same velocity as the plane moves with; the plane, therefore, having induced the *same* degree of rarefaction behind it, will, of necessity, experience the same degree of pressure. Or the case may be illustrated this way:—Let the receiver of a condenser be filled with air at the surface of the earth, and then elevated in the atmosphere until (an aperture being opened into it) the air will flow out (of course, in its *rarefied state*,) with the velocity v. The difference of the pressure of the air at the surface of the earth, and its pressure at the height to which the receiver would have to be elevated, will be the same as that experienced by the plane, and, obviously, the same as in the previous case. The solution, in this case, is exhibited by the formula

$$\overline{p}=14\cdot7279-\frac{14\cdot7279\times27{,}864\cdot7}{27{,}864\cdot7+h}\ldots\ldots\ldots\ldots\;(2).$$

Which formula results from the following proposition, viz.: ∴ the height of the atmosphere + the height due to the velocity: the pressure of the atmosphere : : the heigh of the atmosphere : a fourth quantity, which being subtracted from the pressure of the atmosphere, gives the pressure of the partial vacuum required, or

$$\therefore 27{,}864\cdot7+h : 14\cdot7279 :: 27{,}864\cdot7 : \frac{14\cdot7279\times27{,}864\cdot7}{27{,}864\cdot7+h}=n.$$

$$\text{or } \overline{p}=14\cdot7279-n.$$

Here, as in the case of the positive pressu e, it is the *final* density of the air which answers to the velocity. But in this case the position of things is reversed, for here the pressure of the atmosphere is the *initial* pressure, and

the *final* pressure has to be inferred from the velocity. In the case of the *positive* pressure, however, as we have before seen, it is the pressure of the atmosphere which is the *final* pressure, the *initial* pressure being that which has to be inferred from the velocity; the difference of the *initial* and *final* pressures being the same as the positive and negative pressures in both cases.

The total resistance experienced by the plane or the sum of the positive and negative pressures will be, therefore,—

$$\overline{p}+p=\frac{14{\cdot}7279\times\overline{27{,}864{\cdot}7+h}}{27{,}864{\cdot}7}-14{\cdot}7279+14{\cdot}7269-\frac{14{\cdot}7279\times 27{,}864{\cdot}7}{27{,}864{\cdot}7+h}$$

$$=\frac{14{\cdot}7279\times\overline{27{,}864{\cdot}7+h}}{27{,}864{\cdot}7}-\frac{14{\cdot}7279\times 27{,}864{\cdot}7}{27{,}864{\cdot}7+h}\ldots\ldots\ldots\ldots(3).$$

Which is the formula given in the first essay, as applicable to slow motions, understanding by that term all velocities up to the greatest velocity attainable on a railway. For these velocities, I believe it will be found to give results sufficiently correct, though not rigidly so itself, the near approximation being, as we shall see presently, owing to a compensation of errors.

I shall perhaps be excused making in this place a digression, with the view of offering a remark on the subject of the solution usually given to problems of finding the velocity, with which atmospheric air will rush into a vacuum. The solution given by Dr. Hutton (Tract 38, Problem 24,) is as follows:

$v=.2\sqrt{27{,}720.\times 16\tfrac{1}{12}}=1335$, feet per second.

While he assumes $27{,}720.=$ feet height of the atmosphere supposing it to be homogeneous, and $16\tfrac{1}{12}=$ feet height which a heavy body falls in the first second of time, and $v=$ the velocity required.

All other solutions which I have seen are similar to this, but are *true* only on the supposition that the air is *inelastic*, and its density the density of the external atmosphere. It is perhaps scarcely necessary to observe that this supposition, as far as it assumes the air to be *inelastic*, is utterly incorrect; the solution given above is, therefore, so far erroneous, as it applies only to a case which does not exist in nature.

Resuming the consideration of the *positive* pressure:—it has been before remarked, that as the air immediately in front of the plane must of necessity be exposed to pressure, so its density must of consequence be increased, and if the temperature remained the same, the density attained would be directly in proportion to the pressure. Assuming this to be the case, and reverting to the formula given above for determining the positive pressure, it was observed that the quantity m, or $\dfrac{14{\cdot}7279\times 27{,}864{\cdot}7+h}{27{,}864{\cdot}7}$, exhibited the total pressure in front of the plane, including the pressure of the atmosphere. Calling the density of the atmosphere in its ordinary state 1, and its pressure 14·7279, then $\dfrac{m}{14{\cdot}7279}$ will be $=$ density of the air immediately in front of the plane, or density *due* to what may be called the *original* pressure, or the pressure arising simply from the inertia of the air, without regard to its elasticity. Now, as the density of the air, instead of being uniform, increases from 1 to $\dfrac{m}{14{\cdot}7279}$, its resistance therefore to the plane will be the same as that of an *inelastic* fluid of the mean density between the two. But as the density of the air increases from 1 to $\dfrac{m}{14{\cdot}7279}$ in *geometrical ratio*, therefore the mean required is the *geometrical mean*, or $\sqrt{1\times\dfrac{m}{14{\cdot}7279}}=\sqrt{\dfrac{m}{14{\cdot}7279}}$. Therefore as the term, m, exhibits the resistance, (including the pressure of the atmosphere,) supposing it to be *inelastic*, and of the *final* density, so $m\times\sqrt{\dfrac{m}{14{\cdot}7279}}$ exhibits the total pressure, supposing the atmosphere to be *inelastic*, and its density the geometrical mean density. To determine the (corrected) positive pressure, from which the pressure of the atmosphere must be

deducted: that is, the corrected expression, for the positive pressure becomes—

$$p = m \times \sqrt{\frac{m}{14 \cdot 7279}} - 14 \cdot 7279 \ldots\ldots\ldots\ldots (4).$$

In like manner, as there is a constant compression of the air going forward before the plane, so likewise must the air flowing in behind it be constantly undergoing the process of rarefaction, the effect of which will obviously be to diminish the negative pressure: the proper mode of estimating which effect, judging from analogy, we may presume to be similar to the case of the positive pressure; it being reasonable to infer, that as the law, in the two cases, is so far similar with respect to the original formula (the law being in one case a counterpart to that in the other,) we may conclude that the *virtual* density for the purpose of calculation is the same as the geometrical mean between the initial and final densities, as in the case of the positive pressure. This gives us the corrected expression for the negative pressure—

$$\bar{p} = 14 \cdot 7279 - n \times \sqrt{\frac{14 \cdot 7279}{n}} \ldots\ldots\ldots\ldots (5).$$

Adding the two pressures together we have for the total corrected resistance

$$p + \bar{p} = m \times \sqrt{\frac{m}{14 \cdot 7279}} - 14 \cdot 7279 + 14 \cdot 7279 - n \times \sqrt{\frac{14 \cdot 7279}{n}} =$$

$$m \times \sqrt{\frac{m}{14 \cdot 7279}} - n \times \sqrt{\frac{14 \cdot 7279}{n}} \ldots\ldots\ldots\ldots (6).$$

Which is the corrected formula, as given in the last essay.

On comparing this formula with the formula (3), before given, as applicable to *slow* motions, it will be found that, as far as *slow* motions are concerned, there is scarcely any difference in the results of the two; in the formula (3), the errors in the positive resistance being very nearly compensated by an opposite error in the negative resistance. But in the case of rapid motions the results will be found to be very different, the original formula for slow motions (3) giving the resistance very much too little.

The theory, as so far given above, exhibits no allowance or compensation for the effects of friction, variation of temperature, or other incidental circumstances attending the motion of bodies through the atmosphere. Having treated at some length, in the last essay, on the subject of these causes of discrepancy between the results of the theory and results drawn from experiments, I here refer to the same, for a further elucidation of this subject.

I am, Sir, yours, &c.

JOHN POTTER.

Chorlton-on-Medlock, March 16, 1848.

THE EQUATION OF VIRTUAL VELOCITIES.

Sir,—The following investigation is, as far as I know, original; at any rate it will, I think, put the equation of virtual velocities in an intelligible and interesting point of view.

I assume, as already known, the equations

$$v = \frac{ds}{dt} \qquad f = \frac{dv}{dt} = \frac{d^2 s}{dt^2}.$$

These necessarily arise from the definitions of force and velocity.

Definition.—The work done by a force is measured by the product of the mass moved into the accelerate force into the space divided by the time, or according to the usual notation,

$$\text{Work} = \frac{mfs}{t}.$$

(1.) I assume that every force does its own amount of work in its own direction unaffected by any other forces which act; or in other words, that if a force be acting

it makes no difference, *as far as the work done by that force is concerned*, whether other forces act at the same time or not.

Cor.—Hence forces are equal which do equal works, other things being equal.

(2.) If any number of forces act upon a particle of matter, that particle will usually begin to move; if the forces do not change during the motion the direction of motion will not change, and hence a single force might be substituted which would do the same work as the system. This proves the possibility of the composition and resolution of forces. The same is true if the forces do change; only in this case they must be supposed to work during a time too small for any change to become sensible.

This being premised, the whole of the statics may be deduced from a single equation in dynamics.

(3.) Let o be the origin of the three rectangular coordinates, ox, oy, oz, axes, in any particle of mass m, x, y, z, its coordinates, X, Y, Z, forces acting on it; δx, δy, δz, small spaces described under the action of these forces during time, δt.

Then the whole work done in time, δt, is

$$m\mathrm{X}\frac{\delta x}{\delta t}+m\mathrm{Y}\frac{\delta y}{\delta t}+m\mathrm{Z}\frac{\delta z}{\delta t};$$

$$\text{but X, Y, Z,} = \frac{d^2x}{dt^2}, \frac{d^2y}{dt^2}, \frac{d^2z}{dt^2} \text{ respectively,}$$

and hence,

$$m\mathrm{X}\ \frac{\delta x}{\delta t}+m\mathrm{Y}\frac{\delta y}{\delta t}+m\mathrm{Z}\frac{\delta z}{\delta t}=m\left\{\frac{d^2x}{dt^2}\ \frac{\delta x}{\delta t}+\frac{d^2y}{dt^2}\ \frac{\delta y}{\delta t}+\frac{d^2z}{dt^2}\ \frac{\delta z}{\delta t}\right\}$$

and the whole work done in time, t, is found by diminishing δx, δt, &c., without limit, and taking the integral.

$$\therefore\ \int\left\{m\mathrm{X}\frac{dx}{dt}+m\mathrm{Y}\frac{dy}{dt}+m\mathrm{Z}\frac{dz}{dt}\right\}dt=\tfrac{1}{2}m\ \left\{\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2+\left(\frac{dz}{dt}\right)^2\right\}$$

a constant being added;

$$\text{or } \int m\,(\mathrm{X}\,dx+\mathrm{Y}\,dy+\mathrm{Z}\,dz)=\tfrac{1}{2}m.\left(\frac{ds}{dt}\right)^2+c^2$$
$$=\tfrac{1}{2}\,mv^2+c^2.$$

or if V be initial velocity of system before forces began to act,

$$m\int(\mathrm{X}\,dx+\mathrm{Y}\,dy+\mathrm{Z}\,dz)=\tfrac{1}{2}m\,(v^2-\mathrm{V}^2):$$

hence the work done upon a system is $\frac{1}{2}$ the mass multiplied into the square of the velocity at the end of their motion, minus $\frac{1}{2}$ mass multiplied into square of velocity at the beginning.

(4.) Suppose it should so happen that the forces are in equilibrium, then no work is done. Hence,

$$\int(\mathrm{X}dx+\mathrm{Y}dy+\mathrm{Z}dz)=\mathrm{C},$$
$$\therefore\qquad \mathrm{X}dx+\mathrm{Y}dy+\mathrm{Z}dz=0,$$

the equation of vertical velocities. Moreover, since dx, dy, dz, are independent, we have the three statical equations—

$$m\mathrm{X}=0,\ m\mathrm{Y}=0,\ m\mathrm{Z}=0.$$

(5.) Again, since by (2) a single force might be substituted for the three forces acting, let R be this force, and let a, β, γ, be the angles R makes with ox, oy, oz, respectively; then we must have by (1) work done by R=work done by X, Y, Z, or $m\mathrm{X}\ dx+m\mathrm{Y}\ dy+m\mathrm{Z}\ dz=m\mathrm{R}\ dr$; but $dr=dx\cos a+dy\cos\beta+dr\ \cos\gamma$, and hence $\mathrm{X}=\mathrm{R}\cos a$, $\mathrm{Y}=\mathrm{R}\cos\beta$, $\mathrm{Z}=\mathrm{R}\cos\gamma$.

(6.) In many books it is customary to regard the principle of virtual velocities as insufficiently proved; and a great stumbling-block it seems to be, that the system may have any small displacement whatever, and the principle remain true. But when we look upon the forces as working through the indefinitely small space, during which they may be considered not to change, there is no difficulty; for as the system

is in equilibrium, no work is done in any direction, *i. e.*, the work which would be done in any direction is zero, as long as the conditions of equilibrium are not affected by the change; and, by hypothesis, the forces do not change through the indefinitely small spaces dx, dy, dz; and hence dx, dy, dz, may have any *relative* magnitude and any sign, or the system any motion.

(7.) Hitherto our reasonings have only extended to a single particle, but we can readily extend them to any number of particles, and through them to any rigid body whatever.

It is manifest, that if we had any number of unconnected particles, m_1, m , m_3, acted on by forces X_1, Y_1, Z_1, X_2, Y_2, Z_2, X_3, Y_3, Z_3, &c., then $\Sigma. m.$ standing for the words, sum of all the quantities m_1, m_2, m_3, &c.

We have, by simple addition,

$$\Sigma \left\{ m. \int (X\,dx + Y\,dy + Z\,dz.) \right\} = \Sigma . \frac{m}{2} (v^2 - V^2) \ldots\ldots (a)$$

(8.) Now, suppose the particles rigidly connected by inextensible rods without weight, then we should have to include the tension of the rods amongst the acting forces; but it will be seen that the tensions do no work, and hence equation (a) is true as it stands; for the tensions may be considered as pairs of equal and opposite forces.

Now a rigid body is a number of particles joined together by tensions derived from cohesion; and so long as we may consider the forces which hold its particles together as of the same nature as rigid rods, *i. e.*, if the body be what in mechanics is called rigid common equation (a) applies, and then X, Y, Z are impressed forces.

And, generally, it applies in any system which can be imagined where the *forces of connection*, as they may be called, do no work, as these may be omitted from the consideration, and only the *impressed external forces* need be considered.

(9.) Suppose, however, independently of the internal forces in the system being such as may be neglected, that the external forces are in equilibrium—

Then no work is done, and hence

$$\Sigma \left\{ m \int (X\,dx + Y\,dy + Z\,dz.) \right\} = \text{a constant.}$$

$$\Sigma \left\{ m\,(X\,dx + Y\,dy + Z\,dz) \right\}$$

but since dx, dy, dz are independent, we have

$$\Sigma\,(m\,X) = 0 \text{ (I.) } \Sigma\,(m\,Y) = 0 \text{ (II.) } \Sigma\,(m\,Z) = 0 \text{ (III.)},$$

or the system has no motion of translation.

But if the forces be in equilibrium, it has no motion of rotation either. (See *Pratt's Mech.*, p. 51.)

This will give

$$\Sigma\,(m\,Y\,z - m\,X\,y) = 0 \ldots\ldots \text{(IV.)}$$
$$\Sigma\,(m\,Z\,x - m\,X\,z) = 0 \ldots\ldots \text{(V.)}$$
$$\Sigma\,(m\,X\,y - m\,Y\,x) = 0 \ldots\ldots \text{(VI.)}$$

The principle of *vis viva*, then, admits of the simple statement in words:—

The whole work done in a system is the sum of the work done in its different parts.

And the principle of *virtual velocities* thus:—

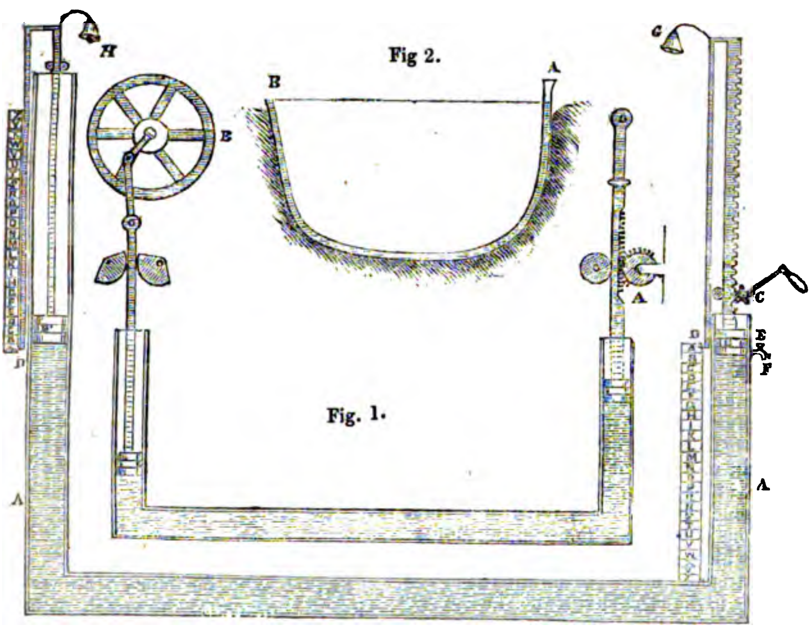
If a system be in equilibrium, the work done in any direction, during an indefinitely small displacement, is zero.

I am, Sir, yours, &c.,

da.

A Rival to Chloroform.—A new agent for producing insensibility to pain has lately, it is asserted, been discovered in Norway, and tried with much success in Christiana. The *Morgenblad* states that it consists of sulphate of carbon, which may be obtained in abundance from charcoal with very little trouble and at a small cost. It is employed in the same way as chloroform,—the place of which it will probably soon take. The discovery was made by M. Herald Thaulow, an apothecary in Christiana.

THE HYDRAULIC TELEGRAPH TWENTY YEARS AGO.



[Our esteemed friend, M. Jobard, director of the *Musée de l'Industrie Belge*, writes to us that he invented and published, about twenty years ago, a hydraulic telegraph of the same description as Mr. Jowett's; and, in support of his claim, he has sent us a number of a Brussels journal called *Le Manneken*, (after the well-known statue,) dated Sept. 27, 1827, in which the publication was contained. We give a translation of the account as we there find it. The "*Nilecram Darobi*" of the article is no other than *Marcelin Jobard*, in an anagrammatical fancy suit.—Ed. M. M.]

Hydraulic Telegraph, working night and day, and communicating instantly to any distance, without intermediate positions, and with a great saving in the construction. Invented by Mr. Nilecram Darobi, citizen of Kentucky.

Fig. 1.—AAA is a tube or pipe, of an inch and a half in diameter, filled with water up to the pistons, B B′. If, by means of the handle and of the gearing, C, the piston, B, is made to descend to a certain extent, the other floating piston, B′, ascends to the same extent. Being enabled by these means to place the pointer or index, D, on any letter of the alphabet, the other index, D′, will stop on the corresponding letter, and thereby any required word may be formed.

(*Objections.*) Mr. Nilecram Darobi, after having submitted his invention to the examination of the most distinguished professors of the country, answers in the following manner all the objections that were urged against the invention:

First Objection.

An extraordinary degree of power, and a considerable space of time, would be requisite, in order to make the telegraph work at great distances.

Reply.

AB, (fig. 2,) is a tube, placed across a valley, from one mountain to another, and filled with water until the extremity, B, is nearly overflowing. It is evident that if a litre more were poured in at the other extremity, A, of the tube, the water would instantly find its level, and half a litre would fall out at the end, B. Hence, neither great power nor a great

space of time is requisite to make the piston, B′, work (fig. 1). All that the power employed has to do is to raise a weight equivalent to the pressure of a column of water of an inch and a half, and to the weight of this said column of water of a length of three or four feet, with the addition of such friction as may be due to the pistons, the whole being probably equivalent to forty pounds; or the gearing and the handle might allow of a power fifty times more considerable being obtained by the hand.

Second Objection.

The compressibility of water will not allow of the piston, B′, travelling the same distance as the motive piston, B.

Reply.

Nothing is less established than the compressibility of water. The academicians of Florence have utterly denied it; and the more recent experiments of Davy have, at best, only shown it to be compressible when under a force of several millions of pounds. The compressibility, too, which Davy supposed he had demonstrated, may possibly have been owing to the elasticity of the sides of the cylinders of the hydraulic press, to the entrance of water into the pores of the metal, or to the gases contained in the water. At all events, it is certain that a power of forty pounds will not give any sensible compression to the water.

Third Objection.

The expansion and condensation of the water in the tubes, produced by the variations of the atmosphere, being accompanied by the same effects on the tubes themselves, will not permit of a perfect level being preserved.

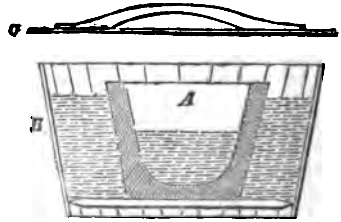
Reply.

The tubes will be buried about a yard deep in the earth;—there, they cannot be affected by any variations of temperature; and even were they to be thereby affected, the cock, F, would enable the superfluous water to flow off, while the tubing, E, would serve to supply any quantity of water deficient in the tube.

Before beginning to work the telegraph, one of the attendants rings the bell, G, which gives warning to the attendant at the other extremity, and the communication is not commenced until the bell has been rung in reply.

Mr. Nilecram Darobi was induced, by this idea, to construct on the banks of the river Hudson a mill, which, putting in motion the wheel A, (fig. 1,) communicates a rotary motion to the fly-wheel, B, placed at a distance of three leagues (about nine miles) from the river, thereby working a saw and a hydraulic pump. The principle is the same as that of the hydraulic telegraph, only that the tubes should offer a resistance proportionate to the motive force.

AN EXCELLENT DOMESTIC FILTER.



Sir,—I have for many years used a filter in the form of the vessel, A, made of grit or free stone, known geologically as being of the new red sand-stone formation. It is somewhat in shape like a common flower-pot, with the sides and bottom from 1½ to 2 inches thick. It may be placed in a large tub, B, having a cover, C, merely to keep it free from dust, or, as is obvious, it would suffice to cover only the filter, A. It never stands so evenly on the tub bottom but the water will penetrate from below, as well as through the sides, and may be ladled out of A with a bowl, kept swimming in it.

I am aware that stone filters, formed like an inverted bee-hive, are very common for ships' use, but they have to be *suspended* in a frame, and the water to be filtered is poured *into* A, instead of being at the outside. The Society of Arts also rewarded an arrangement of a similar stone filter in 1811, the invention of Mr. William Moult; but this is likewise of the bee-hive shape, and is recommended to have a syphon, to draw off the filtered water from A into a suitable cistern, all which makes it complicated and expensive.

The filter I use may be made by any

stone-mason, and, if plentifully supplied, in London would afford a good trade. They have the advantage of being easily cleaned by simply scrubbing them inside and out with a piece of grit-stone and water, if, after a few weeks' use with bad water, the water does not percolate freely.

I am, Sir, your obedient servant,

H. D

DEFINITION OF THE SPHEROIDAL STATE OF BODIES (SEE MECH. MAG. VOL. XLIII. P. 12, AND VOL. XLVII. P. 374.) BY M. BOUTIGNY.

[Translated from the *Moniteur Industriel*, March 16, 1848.]

M. Boutigny states that he has remarked, among the various properties possessed by bodies in a spheroidal state, five which appear to him characteristic and fundamental. They are,—

1. The rounded, or spheroidal form, which a body assumes on a surface heated to a certain degree of temperature.

2. The fact of the permanent distance existing between the spheroidal and the spheroidalizing body.

3. The property of reflecting radiated heat.

4. The suspension of chemical action.

And, 5. The fixity of the temperature of bodies in the spheroidal state.

Upon these five properties M. Boutigny proposes to base the following definition:

A body projected upon a heated surface is in the spheroidal state when it assumes a rounded form, and maintains itself upon that surface, apart from any physical or chemical activity; it then reflects radiated heat, and its molecules are, in respect to heat, in a state of stable equilibrium, that is to say, at an invariable temperature, or at a temperature which varies only within very narrow limits.

ELECTRO-MAGNETIC ENGINES.—THEORY AND PRACTICE.

Sir,—In number 1284 of your excellent Magazine "Tartaglia" has wrought himself into a tempest of fury on a subject which, to use a hackneyed phrase, (and which "Tartaglia" may condescend to forgive, as coming from one of "the unlearned,") is as old as the hills—that is, the ingratitude of mankind. "Tartaglia" laments that "thus it ever is:—men who exert themselves to instruct the uninstructed, and to diffuse a knowledge of the accurate sciences amongst the practical (*query*, impracticable?) classes, are sneered at and ridiculed in the language of the workshop," &c.

Perhaps, after all, this is one of the laws which attaches itself to humanity, particularly "the uninstructed" portion of the species, who are doomed to frequent "workshops." It need not, therefore, be wondered at, that such men as "Tartaglia," who dwell in the upper regions of pure abstraction — whose minds have been sublimated in the crucible of science—should know so little of the workshop portion of the species as to attempt the "abrogation of the positive laws of nature" with respect to this substratum of prostrate humanity.

Some of "Tartaglia's" illustrations do not soar very much above workshop phraseology: instance the case "of substituting the tongs, when the poker had leave of absence, for stirring his study fire." This *elegant extract* is in reference to what is considered by "Tartaglia" as one of Mr. MacGregor's "direct and tangible" objections; that is, "that the usual mode of imparting any considerable magnetic power to soft iron, requires the bar to be surrounded by a coil of wire, which will take up a considerable space, and separate the magnets in the wheel to some distance from each other."

Adverting again to the poker and tongs illustration. Suppose one magnet to be as straight and as *stiff* as a *poker*, and suppose the two adjoining magnets on each side of this said poker to assume the shape of a bandy-legged pair of tongs, all uniting compactly at the centre, then at the circumference of the wheel there will be ample space for several large coils of wire without coming into contact with each other.

Perhaps, Mr. Editor, you will excuse a short digression, simply to state the mode by which "uninstructed" mechanics gauge the intellectual calibre of those scientific gentlemen to whom they sometimes submit their inventions. Should the *sçavan* begin to quarrel with details, with the mere *modus operandi* of the project, he is immediately set down as a *noodle*, whose mind has been minimised by some fatal process, and no further questions are asked.

"Tartaglia" is quite mistaken when he asserts that practical men "entertain a supreme contempt for theory." They do not hold theory in contempt; neither do they like to be held in contempt themselves, nor to have the *birch* brandished so fiercely over their heads as "Tartaglia" seems inclined to brandish that never-to-be-forgotten weapon. But it will be necessary to draw to a close, lest so great a luminary as "Tartaglia," "in an evil hour," retire from the hopeless and unavailing task of endeavouring "to furnish to the practical engineer and the artisan some ideas on the *first principles* of the science of mechanical operations;" and lest these benighted classes should be deprived of the forthcoming lucubrations, which are "to show *what theory is*, and *what functions theory performs* in the mechanical arts."

Will "Tartaglia" be kind enough to point out (in his promised papers upon *what theory is*) how many of the improvements in mechanical science, which have been effected during the last half century, have been effected by purely scientific men, and how many by practical men? We shall then be enabled to put the saddle on the right horse.

A few words with Mr. MacGregor. He accuses me of misquoting. The passage shall therefore be restored agreeably to this gentleman's wishes: "It will be seen that the magnetic attraction, when most powerful, will be acting in the *worst possible* direction for the production of rotary motion." I have always considered that the worst possible direction of any power for the production of motion, was diametrically opposite to the best possible direction, and I think that Mr. MacGregor will have some difficulty to establish that fact in the present instance; at all events, to the full extent which his words imply.

I am, Sir, yours, &c.,

FAIRPLAY.

THE ARTIFICIAL PRODUCTION OF PRECIOUS STONES. BY M. EBELMAN.

[From the *Comptes Rendus*, August, 1847.]

The process adopted by the author is, in reality, a crystallization of the compound from a fused solution of their constituents in boracic acid, the acid being evaporated by heat.

Alumina and magnesia, in proportion to form spinel, were mixed with fused boracic acid and one per cent. bichromate of potash. Exposed on platina foil to the highest temperature of the porcelain furnace of Sèvres, a product was obtained, the surface and interior cavities of which were covered with crystalline facets, having the form of the regular octahedron, rose-red, transparent, and readily-scratching quartz. They were completely infusible by the blow-pipe, and there can be no doubt of their identity with spinel.

A substitution of protoxyde of manganese produced large laminæ, having the form of equilateral triangles or regular hexagons. These were apparently manganesian spinel, which has never yet been found in the mineral kingdom. Oxide of cobalt substituted for magnesia, gave blue-black, regular, octahedrons.

Alumina and glucina, in proportions to form chrysoberyl, gave a mass with a crystalline surface of great splendour, and scratching quartz, and even topaz. The hardness was, therefore, that of natural chrysoberyl.

Silicates, infusible in furnaces, can be formed by the same process. The constituents of emerald gave a substance which readily scratched quartz, and had the form of the regular hexagon.

NEW EXCITING FLUID FOR GROVE'S BATTERY. BY C. DEWY.

The sulphate of soda continues to be used with success in the batteries of the magnetic telegraph (United States). The dilute sulphuric acid must be kept saturated with the sulphate of soda to ensure entire success. The mercury does not in this condition appear to be attacked on the amalgamated zinc. The high solvent power of this solution may, as suggested, be one advantage. The chief result, however, is in preventing the nitric acid from uniting with the mercury. As nitrate of soda is found in the solution, it must be that the sulphate of soda is decomposed, and nitrate of soda formed by the action of the voltaic power, when this will not take place in ordinary cases, or without this electrolysis. The sulphuric acid of the Glauber's salt is set at liberty to act on the zinc, and thus a permanent action maintained, provided the waste of the nitric acid in the porous cup be occasionally and duly supplied by

new portions of the acid. I have seen only a teaspoonful or two of the acid used at a time to supply this waste. The action of the battery appears more uniform by the use of the Glauber's salt. No successful attempt to prevent the destruction of the mercury in this battery had been made until this use of the Glauber's salt, or of alkaline sulphates. —*Silliman's Journal.*

THE "SCOTIA" STEAMER.

On Thursday a new steam vessel, named the *Scotia*, built for the Chester and Holyhead Railway Company, and intended to run between Holyhead and Kingstown, made her first trial trip down the river. She is of 720 tons burden, and of 400 horse-power (nominal). The engines have been built by Messrs. Maudslays and Field, and are on their well-known double-cylinder plan. The vessel has a very light and buoyant appearance on the water; nor did her performances belie the expectations excited by her admirable build. She performed the entire distance between Blackwall and Gravesend, against a strong tide and wind, within the hour, and went over the other measured distances much at the same rate. It is estimated that, when fully equipped for sea, with water-tanks filled, and all stores and fittings on board, she will average not less than 18 miles per hour, and may, under favourable circumstances, reach even to 20.

THE ELECTRIC TELEGRAPH IN THE UNITED STATES.

[We quote from Professor Silliman's Journal for January the following particulars of the present state of the electric telegraph in the United States. We do so less on account of any novelty in these particulars, than in order to place on record, the exact extent to which this system of communication has, at this date, been carried by our transatlantic friends. It will be observed, that the greatest number of letters or signs which have been yet conveyed in the United States, is stated to have been 25,000 in an hour and a half, being at the rate of 277 and a fraction per minute. Now, Mr. Bain has actually accomplished in this country 1,000 per minute, and is now on his way to America, to show Brother Jonathan how this, and more, is to be done.—Ed. M. M.]

Each line has its termini, generally giving name to the company that owns and governs it. Intermediate are "stations," varying in number and importance with the length of the line. It matters not how many of these stations are interposed, provided the arrangements for the introduction of the wire at each secure its insulation. No perceptible difference in the current would result were 50 or 100 of these interposed on a well-insulated line. On one of the lines 16 are included in the circuit, each of which can unite to each or all the others—each receiver preserving a closed circuit while the transmitting operator manipulates with his key. Of course, but one writes at a time.

The business of the offices is conducted by operators, copyists, book-keepers, battery-keepers, messengers, and inspectors or repairers. Messages to be transmitted are received, pre-paid, the price estimated by a tariff, whose elements are the distance transmitted and the number of words; the average rate being 25 cents for 10 words 100 miles. These messages vary in value from 10 cents to 100 dollars. Messages thus received are filed according to destination, and sent in order of reception as nearly as the business of the line admits. As a general rule, the stations are written to in rotation, commencing with the most distant; the time used in performing the circuit varying, of course, with the amount of business and the condition of the wires.

In the economy of our lines the number of intermediate offices is of advantage, if their management is competent, as they facilitate the discovery and repair of difficulties and breaks—a consideration rendered important hitherto by the weakness of our structures. Each office has its peculiar call or signal, to which, when the line is in order, an immediate response is expected. Thus *n* expresses New York. The sound is so familiar, as instantly to arrest the operator's attention, though he should be at a distance from the instrument. Thus the American telegraph is phonetic—it appeals to two senses. Long messages have been faithfully recorded from attentive listening to the peculiar sound of the instrument. There are systems of abbreviations, too, many ordinary words and sentences being expressed by a single letter or numeral. By the aid of these and a quick ear, conversation may be carried on between operators with wonderful celerity.

To the skilful operator, the little brass instrument becomes an articulate creature; it not only conveys his written thoughts, but expresses his passing emotions. He detects the individual with whom he converses, and can recognise the effect of his own conversation as producing pleasure, vexation, or indifference. In business correspondence, too, abbreviations render the transmission so rapid that an ordinary pen-

man fails to keep pace with it. On one occasion, with no allowance for repetition or delays, twenty-five thousand letters were transmitted in an hour and a half, by the aid of two instruments and wire, about three average columns. That the actual business capabilities of the wires may be better understood, the brief statistics of a single day's business at one office may not be uninteresting.

Two wires were at work, one through 200, the other through 500 miles. Four hundred and fifty private messages were sent or received, comprising every variety of business and information. The average length of these messages was twenty-five chargeable words, in addition to address, &c. Besides these, three entire hours were occupied in transmitting market and other intelligence, for publication, abbreviated as above. The line was pretty actively employed for sixteen hours, and, being in good order, sixty or more messages were transmitted in rotation, without a word of repetition. A numerical statement of the operations of the telegraph can give, however, but a faint idea either of their importance or value. It should be considered that the invention is used only in cases of urgency and importance—its receipts are not like those of other business, a trifling per centage on previous outlay.

For some time it was supposed impossible to work two independent wires; experience has proved that the inability lay solely in the imperfection of structures. Two copper wires have worked independently and well through 300 miles. The iron wire is expected to work equally well through twice the distance. [Two iron wires have worked independently and separately at the same time, through 500 miles. The superiority of iron to copper has been fully proved.] No mutual influence is exerted by the two currents. Some careful experiments, made with a view to ascertain whether a secondary current might not be induced in one wire from the primary current in the other, proved conclusively that no appreciable effects could be traced on either from any arrangement of the other with relation to battery or ground.

Rain, snow, &c., act as disturbing influences with less power than would be supposed, but in proportion to the excellence of insulation; since at times, during severe storms, lines have worked well through their entire extent, and at others a light shower cuts off even the nearest station.

Aside from the enumerated difficulties, there is one which will probably always act temporarily and to some extent. During thunder storms, elevated metallic conductors affording for the lightning a passage to the earth, the wires will often become so charged, that the fluid in its passage encountering the small wire of the receding magnet as an obstacle, will dart off to the nearest and largest conductor, or melt the smaller wire. Or, if less of the fluid be present, its magnetic effects will be disclosed in the instruments, producing on them a spasmodic effect.

To remedy or prevent such effects, two instruments, simple enough in idea and construction, have been devised. The one consists of a metallic globe, surrounded with a ring of metal, presenting to the globe a number of sharp points. The ring is adjustable, so as to bring the points in the closest possible proximity to the globe and yet prevent contact. It scarcely need be added that the globe is thrown into the main circuit (the current entering by a large, and passing out by a very fine wire): the ring is connected with the ground.

The other arrangement cannot be well understood without the aid of a drawing. The main wire, before coming to the instruments, connects the helices of the receiving magnet with the upright lever. The right standard connecting with the ground, when the atmospheric current charges the magnet the armature is attracted, the lever brought in contact, and the current passes off to the earth. In this way both dynamical and atmospherical currents are "turned out of doors."

Summary of Progress.

		Miles.
Lines complete	about	3,700
Duplicate wires complete	,,	1,000
Lines in progress	,,	3,000
Lines contemplated	,,	2,300
Duplicate wires in progress	,,	2,500
Total		12,500

STRENGTH OF MATERIALS.

[From a paper read before the Royal Scottish Society of Arts, by George Buchanan, Esq., F.R.S.E., the president, as reported in the *Scottish Railway Gazette.*]

Mr. Buchanan began by stating that he did not profess to communicate anything new or original, but would be happy if he could only draw from the stores of information which had of late years been accumulating on this subject, under the hands of very eminent, scientific, and practical men, such leading facts and maxims as might prove a sure guide for our practice; and such truths, when they became known and established on the unerring grounds of experiment and calculation, could not, he thought, be too widely disseminated. The various strains might all be reduced to two kinds, according as the material is either distended or compressed by any force or pres-

sure. From these two all others arise, and either consist or are compounded of them. The tensile strain is the simplest of all, depending neither on the peculiar form of the materials, nor even on the length, but only on a single element, namely, the section of fracture. This peculiarity of the tensile force was explained and illustrated. In regard to cast iron, the result of the extensive and interesting experiments of Messrs. Hodgkinson and Fairbairn was given, and it was found from the mean of 16 different trials of English, Welsh, and Scotch iron, both hot and cold blast, that this material will sustain about 7½ tons per square inch before breaking, the weakest specimen being 6, and the strongest 9¾. The limit of fracture, however, can never be approached with safety, not even within a long distance, seeing that this material is liable to unseen imperfections, and, above all, to snap in a moment without distending itself or giving any warning of danger. Malleable iron, again, is much superior in tensile strength, and, by its remarkable ductility, inspires confidence in a still higher degree; bears no less, at an average, by various experiments of Telford and Brown, than 27 tons—the weakest 24, and the strongest 29 tons; but, before the half of this load is applied, it begins to stretch, and continues stretching up to the limit of fracture. It is, therefore, not only three times stronger than cast iron, but may be safely loaded with five times the breaking weight, or about eight or nine tons.

In regard to the strength of compression, this depends also, as long as the length is limited, on the same element—the section of fracture; but when a long rod or slender pillar is loaded or compressed, it is liable to bend, not for want of strength, but for want of stability, the least flexure turning it off its centre, and breaking it by lateral force, deranging entirely the simple law applicable to short lengths. In regard to cast iron, by far the most satisfactory experiments are those by Hodgkinson and Fairbairn. The mean result gives very nearly 50 tons on the square inch—the weakest 36½ tons, and the strongest 60 tons. It is thus six times stronger in compression than in distension, and hence it is peculiarly recommended for sustaining any superincumbent weight, as in the case of pillars and of bridges, provided the construction is such as to resolve the strain arising from the load into a longitudinal compression. This is often in our power by proper arrangements, chiefly giving a sufficient height and curvature to the arch; but in cases where, for the want of headroom, the arch is unduly flattened or resolved into a straight beam or girder, the danger is that we bring the tensile force into play, and then the use of cast iron is objectionable, or at least requires extreme caution. No direct experiments have been made on malleable iron of short lengths; but from some facts brought out by Mr. Hodgkinson, its strength appears much inferior to cast iron, chiefly from ductility, whereby it gives way much sooner under a load. It will bear 27 tons, probably much more, without fracture; but with 12 tons it yields to the load, contracts longitudinally, and swells out laterally; and this is another very important fact for our guidance in the use of those different materials.

In regard to stone, experiments have been generally made on specimens rather too minute. Like cast iron, the crushing strength is superior to the tensile, and hence its adaptation for buildings, particularly bridges. Craigleith stone will bear 2½ tons on the inch, or upwards of 400 tons on the square foot; Aberdeen granite 600 tons. In regard to bricks he had occasion to make experiments in relation to the great chimney of the Edinburgh gas-works. It became matter of consideration whether the ordinary brick could withstand the pressure of so lofty a column. Trials were therefore made with a powerful hydrostatic press, not on small specimens, but on the actual brick. The ordinary stock brick was found to bear 140 tons on the square foot, and the common fire-brick 157 tons; but the brick of which the chimney is constructed, consisting of a mixture of fire clay and ironstone, bore, a single brick on its bed, no less than 140 tons, equal to 400 tons on the square foot.

The effect of the transverse strain was then considered and illustrated by various experiments and models. The strain is a compound of the tensile and compressive strain, the one part of a beam loaded in the middle being compressed and the other distended, and the beam itself becoming a lever, and acting often with enormous power against its own strength. Hence it became easy to calculate the strength, this being in every case proportional in the first instance to the area of the section of fracture, and this original element modified by the length and depth of the beam, diminishing in exact proportion to the length, and increasing in proportion to the depth.

The transverse strain acting with such severe advantage against our materials, various methods have been contrived for eluding its effects, and for these none is more remarkable than the principle of the arch, the effect of which was illustrated by experiments, and particularly the necessity in flat arches of having secure abutments to

resist the horizontal thrust, and this was frequently accomplished, where there is sufficient head-room, by uniting the extremities of the arch by strong malleable iron rods, in the same manner, as in the case of the roof, the feet of the rafters are united and prevented from spreading by the tie beams; and this is the principle, the securest of all, on which the great iron bridge at Newcastle, now in progress, is constructed, the object of which is to cross the river and valley of the Tyne, on the highest level of the railways on each side, so as to unite them in one uninterrupted line from London to Berwick, and unite the termini of the different railways, now separated three quarters of a mile or more, into one grand central station, a little to the west of the ancient castle. The distance between this station and the present terminus of the York and Newcastle Railway is 3,457 feet, consisting chiefly of the space occupied by the bed of the river Tyne, and the steep bank on each side, well known to travellers in descending from Gateshead-fell on the south, and Dean-street on the north, both to be now superseded by the smooth and level surface of the railway, and by a turnpike road running on the same bridge directly under the line of rails. The steep banks on each side are spanned by stone arches of a very substantial character, the river and low banks by six metallic arches, all of the same dimensions and structure, resting on solid piers and lofty columns of masonry. In the bed of the river the piers are laid on very solid foundations of piles and planking, with concrete, many of the piles 40 feet in length, and driven to this depth through hard gravel and sand till they reach a bed of freestone rock. Nasmyth's celebrated pile-driver is in full operation here, and with wonderful effect, and has come most opportunely in aid of the work; driving night and day, at the rate of 60 or 70 strokes a minute, the pile heads being often set on fire by the rapidity and violence of the blows of the ram. Piers laid 2 feet below low water mark, and raised about 100 feet to the springing of the arches. The arches consist each of four main ribs of cast iron, each in five segments bolted together, and forming one entire arch 125 feet span, and rising 17 feet 6 inches in the centre, and the level of the rails on the upper platform 108½ feet above the level of high water-mark of the Tyne. Depth of the rib 3 feet 9 inches at the springing, and 3 feet 6 inches at the crown, with flanges 12 inches broad, external ribs 2 inches thickness of metal, internal ribs 3 inches. Total sectional area at the crown 644 square inches, which would bear with safety a load of 5,000 or 6,000 tons, and would form, with proper abutments, a strong arch in itself; but for the fullest security, and to prevent the possibility of inconvenience of risk from deflection or vibration, or otherwise, each rib is united at the springing by strong malleable iron bars or ties 7 inches broad and 1 inch deep, of the best scrap iron, and in all twenty-four in number. The railway is supported above the arch, and the roadway suspended from beneath, by hollow cast-iron pillars 10 feet apart, and each 14 inches square, through which are passed strong malleable iron circular bars, binding the whole into one stiff and solid mass. The sectional area of the horizontal bars is 168 square inches, which would sustain upwards of 4,000 tons without breaking, and 1,500 tons with perfect safety, but the whole weight of the bridge will not exceed 700 tons, leaving 800 tons of surplus strength. The railway, which is at the summit level, runs on a level 4 feet above the crown of the arched rib, and is supported in the middle by hollow cast iron trough girders resting on the top of the pillars 10 feet apart, and united by longitudinal timbers laid with strong planking. The roadway runs nearly on a level with the malleable iron ties, leaving a space of about 20 feet clear head-room.

In the whole of the work the utmost pains has been bestowed on materials and workmanship, and in making everything complete, the surfaces, which abut together, being regularly planed or turned, as in machinery; and, from all the arrangements, the most successful results may be anticipated from this bridge. The cost of the iron work and roadway, by the estimates, comes to 112,000*l.*, and the contracts for the bridge and viaducts to something above 300,000*l.*

FIRST REPORT ON THE COALS SUITED TO THE STEAM NAVY. BY SIR HENRY DE LA BECHE AND DR. LYON PLAYFAIR.

[Presented to both Houses of Parliament by Command of Her Majesty.]

The utility of such investigations having been fully recognized, both as regards questions of the greatest importance connected with our steam navy and as bearing on various branches of our national industry, in which the right use of our fossil fuel is so requisite, it is unnecessary to dwell on the practical application of the inquiry.

We would, however, observe, that experiments necessary to ascertain the true practical value of coal, involve a very large series of observations, extended over a considerable period, and directed to special objects of inquiry. The qualities for which

particular kinds of fuel are pre-eminent being so varied, it is impossible to deduce general results from a limited series of observations. Even in the one economical application of coals, their evaporative value, or their power of forming steam, one variety of coal which may be admirably adapted from its quick action for raising steam in a short period, may be far exceeded by another variety, inferior in this respect, but capable of converting a much larger quantity of water into steam, and therefore more valuable in the production of force. A coal uniting these two qualities in a high degree might still be useless for naval purposes, on account of its mechanical structure. If the cohesion of its particles be small, the effect of transport, or the attrition of one coal against another by the motion of a vessel, might so far pulverize it as materially to reduce its value. Even supposing the three qualities united, rapidity and duration of action with considerable resistance to breakage, there are many other properties which should receive attention in the selection of a fuel, without the combination of which it might be valueless for our steam navy.

There is an important difference existing between varieties of coals in the bulk or space occupied by a certain weight. For the purposes of stowage-room this cannot be ascertained by specific gravity alone, because the mechanical formation of the fragments of coal may enable one of less density to take up a smaller space than that occupied by another of a higher gravity. This is far from an imaginary difference, being sometimes as great as 60 per cent., and not unfrequently 40 per cent. The mere theoretical determination of the density of coals would, therefore, give results useless for practice. The space occupied between two varieties of coal, often equally good as regards their evaporative value, differs occasionally 20 per cent., that is, where 80 tons of one coal could be stowed, 100 tons of another of equal evaporative value might be placed, by selecting it with attention to its mechanical structure. These facts are mentioned merely to show that a hasty generalization should not be made, and to account for our drawing attention to these various points as a means of preventing the selection of a fuel from any one quality. We do not, in the present state of this inquiry, consider it proper to offer any recommendation of our own as to particular kinds of fuel, leaving the experimental facts to decide for themselves.

After preliminary experiments had proved that no practical result could be attained by mere laboratory research, it was determined to test each variety of coal on a scale of sufficient magnitude to check the theoretical views by the practical results. As it was impossible for either of us to devote our whole time to this inquiry, our services being required by other official duties, we appointed assistants to superintend its special parts, under our general direction. On the selection of assistants we have reason to congratulate ourselves, their duties having been conducted with great care and skill. To Mr. Wilson, since appointed Principal of the Royal Agricultural College of Cirencester, whose practical knowledge well fitted him for the task, the superintendence of the economical part of the experiments was first confided. To him and Mr. Phillips is due the erection of the boilers, and the experiments to illustrate the practical evaporative power of the coals. After Mr. Wilson had for some time proceeded with the investigation, he was joined by Mr. Kingsbury, who volunteered his services to this department. The latter gentleman was formerly a distinguished student at the College for Civil Engineers, Putney, and, from his engineering skill, has rendered an especial service to this inquiry.

On the translation of Mr. Wilson to Cirencester, the practical superintendence of the investigation was intrusted to Mr. J. Arthur Phillips, a pupil of the Ecole des Mines of Paris. The information obtained had pointed out improvements and corrections in the processes used, to which Mr. Phillips applied himself with much skill and success.

The corrections and the results of his experiments will be found in his appended Report. The excellent scientific education of Mr. Phillips, and his practical resources, rendered his services of great value.

The analyses of coals were intrusted to Mr. Wrightson (a pupil of Liebig), who had fitted himself by special study for an undertaking requiring so much delicacy of manipulation. Mr. Galloway, an assistant at the Museum of Practical Geology, gave his occasional services in analyzing gases and ashes from the furnaces; but he was not wholly retained for this purpose.

Mr. How, a very careful experimentalist, and assistant at the laboratory of the College for Civil Engineers, was appointed analyst after the retirement of Messrs. Wrightson and Galloway.

It is proper to mention, in terms of approbation, the services of the intelligent working engineer, William Hutchinson, whose assiduity soon enabled him to be of more important service than was to have been expected from his position.

The results obtained by the assistants, with accounts of the modes pursued, are appended, in order that the methods may be

examined, and that special attention may be devoted to any particular department of the inquiry.

In the first section of the Appendix, a full description is given of the processes adopted in conducting the practical part of the experiments, as also plans and sections of the boiler, furnace, and apparatus employed.

The second section contains details of the observations and experiments made to ascertain the evaporative power of the different varieties of coals.

The third section describes the formulæ used for calculating the experiments, and for correcting and reducing them to one standard.

The fourth section contains the chemical experiments, including the ultimate and proximate analyses of the coals, and the determination of their calorific values.

It is unnecessary to repeat here the mode in which the experiments were instituted, as these are detailed in the first section of the Appendix, so that it will suffice to draw attention to the points observed in reducing and calculating the results. It will be obvious that there are several circumstances which must receive attention before the true evaporative value of a fuel can be obtained. Thus, the water in the tanks has a varying temperature during the day, dependent on atmospheric changes, and is always different from that in the boiler. The temperature of water in the boiler also varies with the external temperature, and the circumstances under which the experiments are made. The shape of a Cornish boiler favours an inequality in the temperature of the water in its various parts, the colder and denser water sinking to the bottom, and having a tendency to remain there, so that the temperature of water at the surface is far from being the mean temperature of water in the boiler, the difference between the surface and bottom water being, on an average, 70°. Other circumstances naturally affect the evaporative powers of the coal, as, for example, the fact that all the water exposed to the action of the fire in the boiler is not converted into steam, and that wood is used to light the fire. Another circumstance of considerable importance, is the expansion or contraction of the boiler from an increase or diminution of the temperature. In the early stage of the experiments, those conducted by Messrs. Wilson and Kingsbury, it was thought unnecessary to make a correction for this variation in conditions; but, on ascertaining experimentally that the difference was as much as 69·625 lbs. of water in the contents of the boiler, between the temperature 150° and 212°, it became desirable to make an allowance for it, even when the difference between the initial and final temperature was not greater than 10°. Other circumstances, of less importance, but influencing the results, have been neglected, because the application of such corrections would have only complicated the results, and would have had little practical value when the errors of observation in such approximative experiments remain so large. Among these may be mentioned the quantity of gases evolved during combustion, the elevation in temperature of the air entering the fire-place, the barometrical and hygrometric conditions of the atmosphere, the radiation from the boiler (very small in amount, owing to its brick covering), the hygrometric state of the fuel, or the heat necessary for obtaining mechanical draught in the chimney. In most of these cases the necessary observations have been made, to enable the corrections to be applied, should it afterwards appear desirable.

In making the calculation for the evaporative value of a fuel, the quantity consumed was divided into two portions, the first being that necessary to raise the whole mass of water, exposed to the fire, from the *mean temperature* to 212°, the second portion being that required to evaporate the water taken from the tanks from a temperature of 212°. To enable this to be done, the mean temperature of the whole mass of the water is ascertained, that is, the temperature of the water in the boiler at its initial temperature after being mixed with the tank water at its average temperature. The average of the latter was the mean of several observations taken during the day, and is designated by t'.

Let w be the weight of water drawn from the tanks at temperature t'
W ,, in boiler ,, t'' this being obtained from surface temperature corrected by experiment
t temperature after mixture.

$$\text{Then } t = \frac{W\,t'' + w\,t'}{W + w}.$$

The correction for the wood was made from data procured experimentally by Messrs. Wilson and Kingsbury, but it can only be employed for the particular wood used, as in subsequent experiments the evaporative value was found very different from another quality obtained. The coefficients of the evaporative power of the wood may be deduced from experiment, in which a certain weight of water was raised from a

known temperature to the boiling point, and then a certain portion of it evaporated. The following formulæ have been used by Mr. Kingsbury for the calculation—

N is the total weight of wood used in raising $(W+w)$ (the weight of water in the boiler, and of that let down from the tanks during the experiment) from the mean temperature t to 212°; then it is necessary to find the weight N′ necessary to evaporate w from 212°.

Then $\frac{w}{N'}=e$, the evaporating power.

Let m be the weight of wood required to raise $W+w$ from t to 212°, the number 1000 being assumed as the latent heat of steam.

N to evaporate $W+w$ from 212°
N′ „ w „

$$\text{Then } m+N'=N.$$

$$\text{Now } \frac{l}{212-t}=\frac{n}{m}.$$

$$\text{But } \frac{n}{N'}=\frac{W+w}{w}$$

$$\therefore N'=n\frac{w}{W+w}$$

$$l(N-N')=(212-t)\,n$$

[Continued next col.]

$$=(212-t)\,N'\left(\frac{W+w}{w}\right)$$

$$N\,l=N'\left\{\frac{W+w}{w}(212-t)+l\right\}$$

$$=\frac{N'}{w}\left\{(212-t)(W+w)+l\,w\right\}$$

$$\therefore \frac{w}{N'}=\frac{(212-t)(W+w)+l\,w}{N\,l}$$

$$=e$$

or, introducing the value of t as given by the first formula,

$$\frac{(l+212-t')\,w+(212-t'')\,W}{N\,l}=e.$$

If q be the quantity of wood used in lighting the fire, $e\,q$ will be the weight of water evaporated from 212° by the wood, and must be deducted from the weight of water evaporated in calculating the work done by the coal.

The coefficient of the evaporating power of the coals, or the number of pounds of water which one pound of coal will evaporate from 212°, may be calculated as follows:—

Let P be the total quantity of coal consumed, then the work done by P will be to raise $W+w$ of water from t to 212°, and to evaporate $w-e\,q$ from 212°.

Let m be the weight of coal required to raise $W+w$ to 212° from t,
p „ „ evaporate $w-e\,q$ from 212°
n „ „ „ $W+w$ from 212°.

$$\text{Then } \frac{w-e\,q}{p}=\text{E, the evaporating power.}$$

$$\text{Now } P=m+p$$

$$\frac{212-t}{l}=\frac{m}{n}$$

$$\text{But } \frac{p}{n}=\frac{w-e\,q}{W+w}$$

$$\therefore m\,l\left(\frac{w-e\,q}{W+w}\right)=p\,\frac{212-t}{P-p}$$

$$\frac{(W+w)(212-t)+(w-e\,q)\,l}{P\,l}=\frac{w-e\,q}{p}$$

$$=E$$

Introducing the values from which the mean temperature t was obtained (first formula), we have eventually

$$\frac{(l+212-t')\,w+(212-t'')\,W-l\,e\,q}{P\,l}=E$$

in which W is the weight of water in the boiler;
w „ drawn from the tanks during the experiment;
t' the mean temperature of water in tanks;
t'' the corrected initial temperature of water in the boiler.*

* A small correction must be also made for the combustible matter in the *residua* of combustion, such as the soot and carbonaceous matter in the ashes: to do this with great accuracy, a series of observations and analyses would have been required, the labour and expense of which would not have been warranted by the amount of correction necessary. It was, therefore, considered sufficient to proceed as follows,—although the result is nothing more than a very rough approximation to the truth. For such an approximation it will be admitted that the evaporative value of the coal depends on the ratio of the combustible to the incombustible matter, and that this ratio confers a similar evaporative value on the quantity of ashes, cinders, and soot produced by the combustion; in other words, that if the combustible matter of the latter had been usefully applied in the production of steam, a similar effect would have been produced as if a corresponding quantity of coal had been burned. If, then, Q be the weight of coal containing the same quantity of combustible matter as the *residua* after its combustion in the furnace,

$$\frac{(l+212-t')\,w+(212-t'')\,W-l\,e\,q}{(P-Q)\,l}=E',$$

the corrected coefficient of evaporating power.

Let, then, w_1 = weight of ashes after the expe-

In the preceding formulæ, the latent heat of steam has been taken at 1000°, the number generally used in this country; but after all the calculations had been made on this subject from the experiments by Messrs. Wilson and Kingsbury, and the results sent in to the Admiralty, Regnault's excellent memoir on the latent heat of steam was published. It became necessary, therefore, to use these new results in the future experiments. These, so far as they apply to the present inquiry, are reduced in the following Table:—

TABLE No. I.—*Showing the Specific and Latent Heat of Water and Steam.*

Air Thermometer Centigrade.	Mercurial Centigrade.	Number of Unities of Heat abandoned by one kilo. of water in descending from T to 0°.	Air Thermometer Fahrenheit.	Mercurial Fahrenheit.	Number of Unities of Heat contained in one pound of water at T°.	Mean Specific Heat of Water between 0° and T cent. or between 32° & T. Fahr.	Specific Heat of Water from T to T+*d* T.	Latent Heat of Steam saturated to the temperature T.	
								Centigrade.	Fahrenheit.
°	°		°	°					
0	...	0·000	32	...	32·000	...	1·0000	606 5	1091·7
10	...	10·002	50	...	50·003	1·0002	1·0005	599·5	1079·1
20	...	20·010	68	...	68·018	1·0005	1 0012	592·6	1066·7
30	...	30·026	86	...	86·046	1·0009	1·0020	585·7	1054·2
40	...	40·051	104	...	104·091	1·0013	1·0030	578·7	1041·6
50	50·2	50·087	122	122·36	122·156	1·0017	1·0042	571·6	1028·9
60	...	60·137	140	...	140·246	1·0023	1·0056	564·7	1016·4
70	...	70·210	158	...	158·381	1·0030	1·0072	557·6	1003·7
80	...	80·282	176	...	176·507	1·0035	1·0089	550·6	991·1
90	...	90·381	194	...	194·685	1·0042	1·0109	543·5	978·3
100	100·0	100·500	212	212·0	212·900	1·0050	1·0130	536·5	965·7
110	...	110·641	230	...	231·153	1·0058	1·0153	529·4	952·9
120	...	120·806	248	...	249·450	1·0067	1·0177	522·3	940·1
130	...	130·997	266	...	267·794	1·0076	1·0204	515·1	927·2
140	...	141·215	284	...	286·187	1·0087	1·0232	508·0	914·4
150	150·0	151·462	302	302·0	304·632	1·0097	1·0262	500·7	901·2
160	...	161·741	320	...	323·133	1·0109	1·0294	493·6	888·5
170	...	172·052	338	...	341·693	1·0121	1·0328	486·2	875·1
180	...	182·398	356	...	360·316	1·0133	1·0364	479·0	862·2
190	...	192·779	374	...	379·002	1·0146	1·0401	471·6	848·9
200	200·0	203·200	392	392·0	397·760	1·0160	1·0440	464·3	835·7
210	...	213·660	410	...	416·588	1·0174	1·0481	456·8	822·2
220	...	224·162	428	...	435·480	1·0189	1·0524	449·4	808·9
230	...	234·708	446	...	454·474	1·0204	1·0568	441·9	795·4

It also became desirable to introduce new corrections, which the progress of the inquiry showed to be needful. Thus, Mr. Phillips' careful experiments determined the alteration in the capacity of the boiler at different temperatures, and correction was in future made for this difference. The alteration in the capacity of the measuring tanks was also estimated, whenever the temperature differed 2° from that at which they were gauged. Another cause of error, for which allowance should be made, is any difference which may exist betwen the initial and final temperature at the beginniug and close of the experiment. This difference being known by observation, the correction may be applied from the Table of Expansion of the water in the boiler, given in the Appendix. Introducing these new corrections into the experiments for ascertaining the coefficient of the heating power of the wood, the following are the formulæ used by Mr. Phillips:—

$$\frac{(W + w - w')(l + t) + wt' + (w' - w)t''}{P\,l} = E.$$

In which W is the water let down from the tanks during the experiment.

w = The weight of water (as found by the Table of Expansion) found in the boilers at commencement of experiment.

w' = The weight of water in boiler at close of experiment.

l = Coefficient of the latent heat of steam.

t = Quantity of heat necessary to raise the water in tanks from its mean temperature to that at which it is evaporated.

t' = Quantity of heat necessary to raise

riment. w_2 = weight of cinders after experiment.
w_3 = ,, soot ,,

The weight of the cinders is taken after the clinkers are separated.

Let $\left.\begin{matrix} r_1 \\ r_2 \\ r_3 \end{matrix}\right\}$ be the per centage of combustible matter in the ashes, cinders, and soot respectively;

Q the weight of coal containing the same weight of combustible matter;

r the per centage of combustible matter as found in the coal by analysis;

$$\text{Then } r\,Q = r_1\,W_1 + r_2\,W_2 + r_3\,w_3$$

$$\therefore Q = \frac{r_1\,W_1 + r_2\,W_2 + r_3\,w_3}{r}$$

the water in the boiler from the initial to the final temperature.

t'' = Quantity of heat necessary to raise water at the temperature of tanks to the final temperature of water in the boiler.

P = Weight of combustibles consumed during experiment.

E = The co-efficient of the heating powers of wood.

But when the initial is lower than the final temperature, the formula becomes—

$$\frac{(W + w - w')\,l + Wt + wt' + (w' - w)\,t''}{Pl} = E.$$

All the terms retaining their original value except the last, in which t'' is replaced by t''' (or the heat necessary to raise the final temperature to that at which the water was expanded), and must be regarded as having a negative value, while t' becomes positive. If now q is the weight of wood used in lighting the fire, the formulæ for estimating the evaporative power of the coal will be

$$\frac{(W - Eq + w - w')\,l + (W + w - w')\,t + wt' + (w' - w)\,t''}{Pl} = E'$$

And

$$\frac{(W - Eq + w - w')\,t + Wt + wt' + (w' - w)\,t'''}{Pl} = E'$$

As the experiments are strictly comparative, and under like conditions, the want of the other corrections, to which we have alluded above, will not be felt in examining the results; while their execution would have introduced a refinement into the experiments which never could be obtained in practice, and which, in fact, would be useless and unwarrantable, while, as previously remarked, the errors of observation in all such approximative experiments remain so large.

The only omitted correction which in appearance might be supposed necessary for practical purposes, is that for the hygroscopic condition of the fuel. Had wood been employed, this must have been done; but the hygroscopic nature of coal is very much less than that of wood. The latter contains one-fifth of its own weight of hygroscopic water; and the heat necessary for the evaporation of this quantity might be shown by a simple calculation to be nearly equal to 22 per cent. of the total heat obtained by the combustion of the wood The hygroscopic water in coal is however very small, as will be seen by the following determinations of some of the Welsh specimens experimented upon:

	Hygroscopic water.
Graigola Coal..........	1·06 per cent.
Anthracite	2·44 ,,
Old Castle	0·74 ,,
Ward's Fiery Vein......	1·27 ,,
Myndd Newydd	0·67 ,,
Pentrepoth	0·78 ,,
Pentrefelin	0·70 ,,

Had we introduced corrections for these small quantities, practice would have been misled; because the coals will rarely reach a vessel in the dry state that they did in the present case, when they were packed in hogsheads and kept under cover.

It was found unnecessary to correct for any inflammable gases flying up the chimney, because repeated analyses of the chimney gases proved them not to contain any combustible constituent; the only products ever found being carbonic acid, sulphurous acid, oxygen, and nitrogen. The quantity of free oxygen in the chimney varied from one-quarter to half of the oxygen, which combined with the fuel; in other words, nearly twice the quantity of air passes through the fire than that which is strictly necessary by theory.

(To be continued.)

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Ellins, of Droitwich, Worcestershire, salt manufacturer, for certain improvements in manufacturing salt, and in apparatus for manufacturing salt. March 22; six months.

William Edward Newton, of Chancery-lane, Middlesex, for an improvement or improvements in making coupling joints for pipes, nozzles, stopcocks, mill and cylinder heads, and other apparatus. (Being a communication.) March 22; six months.

Henry Bessemer, of St. Pancras-road, Middlesex, for improvements in the manufacture of glass. March 22; six months.

William Henderson, of Parkhead, Lanarkshire, Scotland, chemist, for improvements in treating lead and other ores. March 22; six months.

Joseph Orsi, of Guildhall Chambers, gentleman, for certain improvements in the manufacture of artificial stone cements, ornamental tiles, bricks, and quarries. (Being a communication.) March 22; six months.

William James Dailey, of Lambeth, Surrey, lithographer, for certain improvements in machinery for propelling. March 22; six months.

John Lawes Cole, of Lucas-street, Middlesex, for certain improvements in steam-engines. March 22; six months.

Tanning Ropes.—"Piscatorius." The idea is not new. Fishermen have often been known to dip their nets and lines into tanpits; but though some increase of strength is doubtless acquired by this process, it has never been such, we believe, as to make it worth general adoption.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs
Mar. 18	1388	Wm. Bedington, Jun.	Birmingham	Gas-burner.
20	1389	J. and D. Nicoll	Regent-street and Cornhill	Paletôt.
,,	1390	John Nurse and Robert Warren	Crawford-street, Bryanston-square	Carriage.
21	1391	Blake and Parkin	Sheffield	Three-curved spring for railway carriages, trucks, and locomotive engines, and for all kinds of vehicles on common roads.
,,	1392	Messenger and Sons	Broad-street, Birmingham	Bulbous flower-glass.
,,	1393	Tylor and Sons	Warwick-lane, Newgate-street.	Soda-water machine.
22	1394	Hugh Strath	Brownlow Mews, London	Wash-hand stand and basin.
,,	1395	Cronin, Wheeler, and Co.	Bartlett's-buildings, Holborn	Le chevalier, an ornament for securing pins and brooches effectually in the dress.
,,	1396	Richard Moss	Bartholomew-square, Old-street	Foot-warmer and influenza vapour bath.
,,	1397	Tylor and Pace	Queen-street, Cheapside	Roller for Venetian blinds.
,,	1398	William Marples	Spring-lane, Sheffield	Mortice gauge.

Gutta Percha Company, Patentees,
Wharf-road, City-road, London.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in Bands of an indefinite length, render them superior for almost all working purposes, and decidedly economical.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Haslingden, September 4, 1847.

Dear Sir,—We have now been using the Gutta Percha Straps for the last eight months, and have great pleasure in saying they have answered our most sanguine expectations; and we may add, that some of our machines which required a 12-inch leather strap, and which almost daily required to be repaired, we have been turning the same with the Gutta Percha Straps 10 inches only for the above-named period, and now find them as good as the day they were first applied.

We remain, yours respectfully,
W. & R. TURNER.

To S. Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

Sir,—In reply to your inquiry as to the result of our experience with the Gutta Percha Straps, we have great pleasure in stating that the advantages they possess are so very manifest as to induce us to apply them in almost every instance where new straps are required.—We are, Sir, very respectfully,
SHARP, BROTHERS.

Samuel Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

Sir,—In reply to your inquiry respecting how we like your Gutta Percha Machine Straps or Driving Belts, although we have not had quite so much experience in the above-named use of Gutta Percha as we hope to have, so far as we have employed it it has given us general satisfaction. The beautifully straight and regular manner in which it runs on the pulleys, especially on our cone or speed pulleys, is a strong recommendation in its favour; and although we are inclined to think it does not take so fast a grip on the pulley as leather, yet there is ample hold for all general purposes. We shall continue to use it and to give it our best attention, so as to learn how to employ to best advantage the many excellent qualities it possesses over the ordinary leather belts.

NASMYTH, GASKELL, & CO.

S. Statham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

Dear Sir,—We beg to inform you that we have now had the patent Gutta Percha Bands or Straps in use for more than six months. For tube frames we consider them very much superior to anything we have tried before. They also do very well as open straps for mules, throstles, looms, &c.

We are, Sir, yours respectfully,
THOS. DODGSHON & NEPHEWS.

Mr. Samuel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

Gentlemen,—We have much pleasure in bearing our testimony to the valuable qualities of the Gutta Percha for driving bands. We have found it answer exceedingly well in most cases where we have tried it, and we think it has only to be made known to ensure its very general use.

We are, Gentlemen, yours obediently,
HOLE, LINGARD, & CRUTTENDEN.

To the Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

Dear Sir,—Your letter of the 31st August is to hand, and in answer respecting the use of your Gutta Percha Bands, I cannot give you a better proof of our approval of them in preference to leather straps, than having given an order for another to your partner, yesterday, to be in readiness in case of accident. They are decidedly preferable to the old straps; and we can recommend them with the greatest confidence to any person for Driving Straps.

For HALL & GORTON, THOMAS GORTON.

S. Statham, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.

Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.

TRUMAN, HANBURY, BUXTON, & CO.

To the Gutta Percha Company.

Patent Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton-row, 1st Sept., 1847.

Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.

C. WRIGHT, Boot and Shoe-maker.

To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.

Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion of that time being the most inclement period of the year; and from my occupation as a general post letter-carrier, you may be sure that they have had

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1286.] SATURDAY, APRIL 1, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

MR. MADIGAN'S PATENT TURN-TABLES.

Fig. 1*.

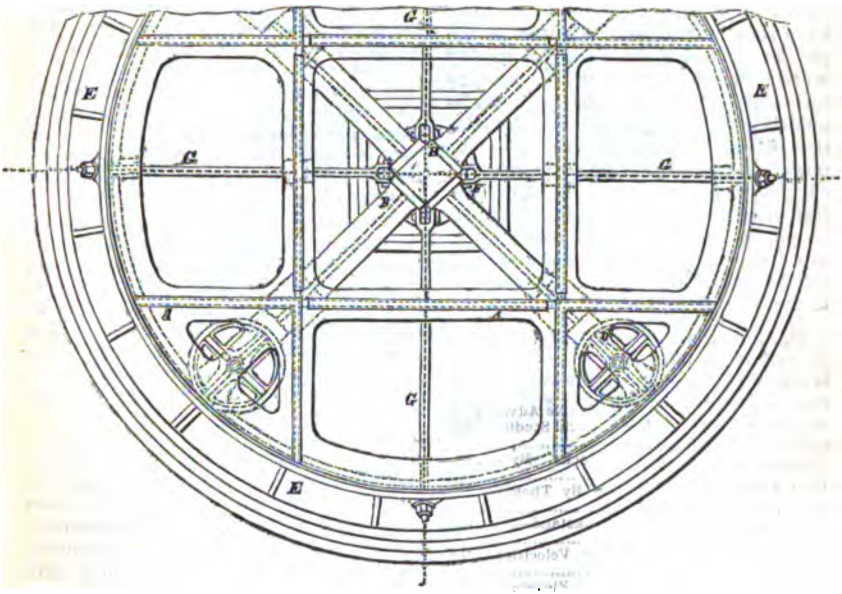
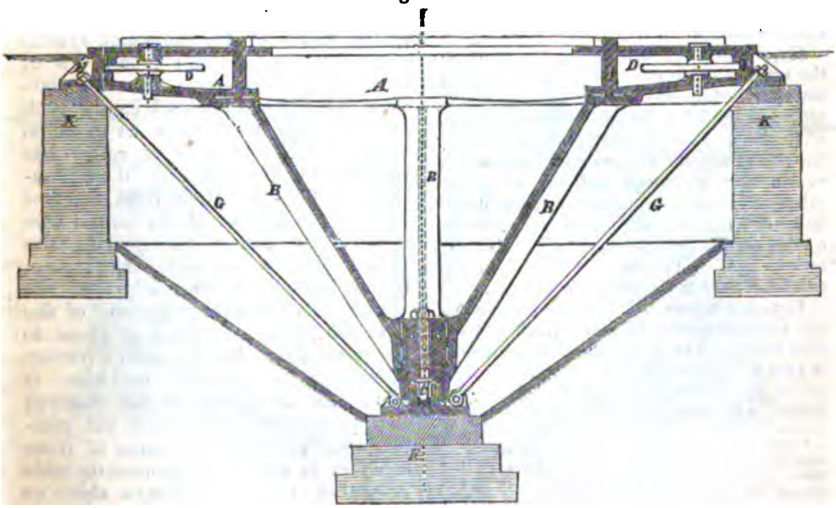


Fig. 2*.



Mr. Madigan specifies a second description of table,* which possesses the following peculiarities:

First, the whole of the weight of the rail, platform, and framework are supported on a central pivot, which rises but a short way above the bottom of the pit, thus bringing the centre of gravity much lower down than in the ordinary turn-tables. *Second*, the platform is guided in its rotary movements by friction-rollers, which, instead of being placed under the periphery as usual, bear edgeways against it. And, *third*, the central pivot and step are completely protected, by means of an inverted air-tight cap, from the intrusion of water and dirt. Of this table, two varieties are described in the following terms:

Fig. 1* is a vertical section, fig. 2* a plan of (part of) a table thus constructed. A, is the rail platform, B, the framework, C, the central pivot, on which in this table the whole weight is thrown; DDDD, the horizontal guide-rollers, which are attached to the rail platform by means of pins, on which they turn easily, and roll against the curb, E, which is turned or bored of a cylindrical form, at that part against which the rollers work. F, is a step or foot for the central pivot to work in, which is connected to the curb by the tie-rods, GG. The curb, E, and step, F, are both firmly bedded on brickwork, KK, masonry, or any other suitable foundation.

Or, instead of constructing the table in the manner which has been so far described, the construction may be modified; as represented in fig. 3* (a vertical section), and fig. 4* (a plan). In these two figures one half of the rollers are, for the sake of illustration, shown in a horizontal position, and in the other half in an oblique position; but it will be readily understood, that in constructing a table of this description, it will be necessary to have all the rollers arranged in the same way, either horizontal or oblique.

Here the rollers, DDDD, are attached to the curb by means of pins, on which they turn freely. The platform or upper frame is provided with a ring, R, which is turned (of a cylindrical form for the horizontal rollers, and conical for oblique rollers,) at that part which works against the rollers. The oblique rollers should also be conical. The angles of both the ring and the rollers may be determined by the method ordinarily used for setting out bevel gear, and which is well known. I would also recommend that in all cases the edges of the rollers should be slightly rounded. H is a screw, for adjusting the height of the table when the oblique rollers are used, which should be screwed down until the whole of the weight is carried by the centre pivot, and the rollers act merely as guides. This adjusting screw may in some cases be applied with the horizontal rollers, but in general this will not be necessary.

To prevent water, dirt, &c., from getting to the centre pivot, I surround it and the step it works in, by an inverted air-tight cap or chamber, I, the air in which prevents the water from rising in it above the step, F, even should the pit be full of water. The step or foot, F, is also formed with a cap round the pivot, large enough to contain as much oil as would be required for a considerable length of time.

A third improvement in turn-tables specified by Mr. Madigan, consists in making them partly of wrought iron and partly of cast iron, and combining them together in a peculiar manner, whereby they may be made not only more cheaply than those in ordinary use, but much stronger and more durable. Without going into the whole of the details of this compound system of combination, we may note a few of its more salient features. The top platform and under framework consist each of an external ring, and a set of radial arms, which are made of rolled bar iron and welded together at their junctions, so that the whole form together but one piece, to which the central boss is afterwards cast on "by pouring iron in a fluid state into a suitable mould, formed round the inner edges of the arms." To effect the "motion" of the top platform, preference is given to "Greenway's Patent Anti-friction Spheres;" and careful provision is made that no portion of the roadway shall project beyond a vertical line, passing down through the centres of these spheres; by which arrangement the table is secured from being shaken about or fractured by the passing of trains over it.

* By an unfortunate oversight, the letters of reference were omitted in the engravings of the table described in our last number. A person acquainted with this class of structures would, however, have no difficulty in supplying them.

Fig. 4*.

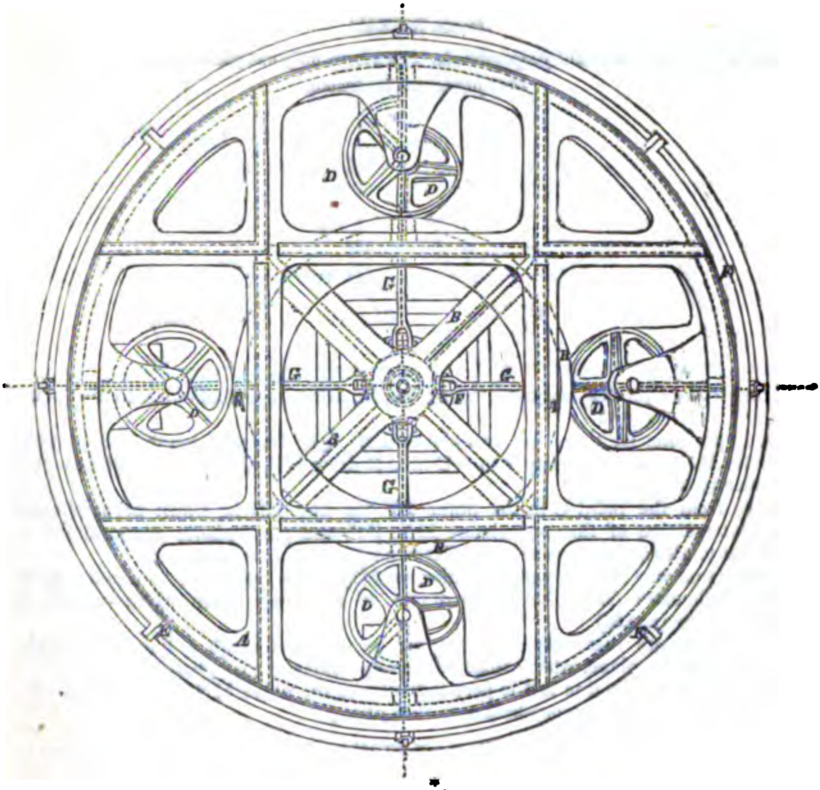
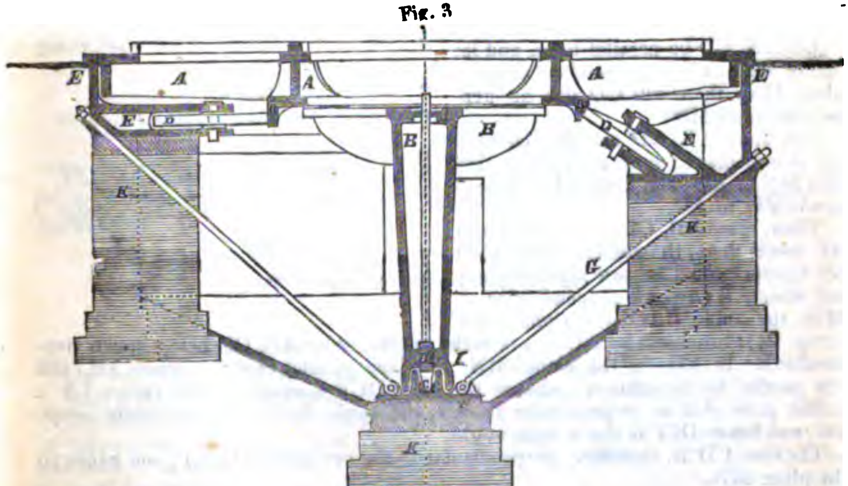


Fig. 3

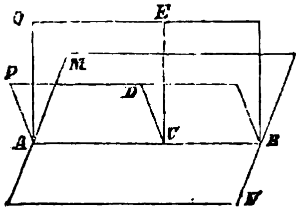


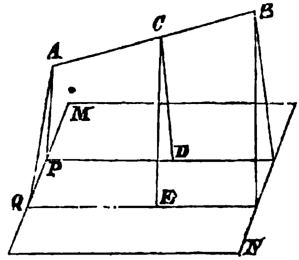
GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from page 203.)

Prop. XXXIII.

Through the same line not perpendicular to a plane, only one plane perpendicular to that plane can be drawn.





Through the line AB only one plane can be drawn perpendicular to the plane MN.

For, if possible, let there be two planes PB, QB drawn through AB perpendicular to MN; and from any point C in AB draw CD, CE in those planes perpendicular to AB.

Then, from the point C in the plane BP the line CD is drawn perpendicular to the intersection of the two planes MN, BP, and these planes are assumed to be at right angles: therefore the line CD is perpendicular to MN.

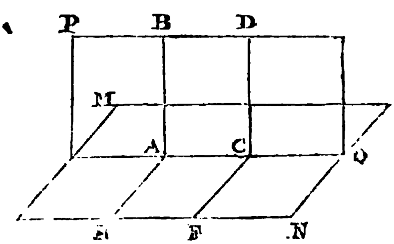
In the same way CE is perpendicular to MN. Whence from the same point two perpendiculars CD, CE can be drawn to the same plane MN:—which is impossible. (*prop.* 26.)

It hence follows that only one plane can be drawn through a line not at right angles to another plane, which shall be perpendicular to that plane.

When, however, the line AB is perpendicular to the plane MN, *all* planes drawn through it will be alike perpendicular to that plane.

Prop. XXXIV.

If one of two parallel lines be perpendicular to a plane, the other will also be perpendicular to the same plane.



Let AB, CD be parallel lines, and let one of them AB be perpendicular to the plane MN: then will CD also be perpendicular to MN.

For, since AB, CD are parallel they are in one plane: let this be PQ, which cuts MN in AC; and draw AE, CF perpendicular to AC.

Then, since AB, CD are parallel and AC meets them, the angles BAC, ACD are together equal to two right angles; and since AB (*hyp.*) is perpendicular tc MN, the angle BAC is a right angle (*prop.* 24): whence also ACD is a right angle. Also AE, CF being drawn perpendicular to AC, in the plane MN, they are parallel, and the lines AB, CB are parallel by hypotheses: whence the angle DCF is equal to BAE (*prop.* 7.)

But since AB is perpendicular to MN, the angle BAE is a right angle (*prop.* 24), and hence DCF is also a right angle.

The line CD is, therefore, perpendicular to the two lines AC, CF, and hence to the plane MN.

Prop. XXXV.

If two straight lines be perpendicular to the same plane, they are parallel to one another. (*Preceding figure.*)

Let AB, CD be perpendicular to MN: they will be parallel to one another.

For, through CD and A draw the plane PQ.

Then, since from the point A the line AB is drawn perpendicular to the plane MN, and since PQ is perpendicular to MN (*prop.* 31), the line AB falls wholly in the plane PQ, and AB, CD are in the same plane (*prop.* 34).

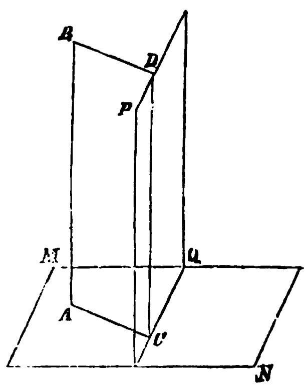
But AB, CD being perpendicular to the plane MN, the angles BAC, ACD are right angles (*prop.* 24), and these lines are in the same planc PQ: whence they are parallel.

Corollary.

1. *A plane which is perpendicular to one of two parallel lines is perpendicular to the other.*

Prop. XXXVI.

If, of two planes, one be parallel, and the other perpendicular to a line, the two planes will be mutually perpendicular to one another.



Let the plane PQ be parallel, and the plane MN perpendicular to the line AB: then MN and PQ will be at right angles to each other.

For, let A be the intersection of AB and the plane MN, and draw AC perpendicular to CQ, the section of the planes: also, through BA, AC draw the plane BC, cutting PQ in CD.

Then, since AB is parallel to the plane PQ, the plane ABC cuts PQ in the line CD parallel to AB (*prop.* 2). Wherefore, the lines AB, CD being parallel, and one of them, AB (by hypothesis) perpendicular to MN, the other, CD, is also perpendicular to MN (*prop.* 34). Consequently, the plane PQ, in which CD is situated, is perpendicular to the plane MN (*prop.* 31).

Corollaries.

1. *If a line AB be parallel to a plane PQ, then any plane MN drawn perpendicular to AB will be perpendicular also to PQ.*

This is, in fact, only a modified form of enunciation, and is only given from its being in a convenient shape for several of the purposes to which the proposition is applicable.

2. *A plane which is perpendicular to a line situated in another plane, is also perpendicular to the plane which contains that line.*

SNYDER'S PATENT PROCESS OF MANUFACTURING LEATHER.

[In vol. xliv., p. 351, we published a letter from a correspondent, strongly recommendatory of the Snyder process of tanning, which had then been recently patented. A company has now been formed for working the patent, which has once more brought the merits of the invention under public notice, and led to our being favoured with a second letter on the subject, from a different but equally friendly pen. We give this second letter also a place in our columns,

because, though like the former, all in praise of the invention, it is, like it too, written in a judicious and truthful spirit. We entertain ourselves a very favourable opinion of the process; and trust that it will have at least a fair trial.—Ed. M.M.]

The process of tanning, by whatever means it is conducted, consists simply in the combination of the gelatine of the skin with the tannic acid, or tannin, of a vegetable infusion. When this takes place under the most favourable circumstances, as when both are in solution, the combination is instantaneous, and in the proportion of 54 of gelatine to 46 of tannin.

The skin of all the higher order of animals is composed of two distinct layers—the cuticle, or epidermis, forming the outer coat, (it is that which is raised by a blister,) and the *cutis vera*, or true skin, which constitutes the internal layer in the animal, and usually the outer and blackened surface of manufactured leather; the latter is called by tanners the flesh, and the former the grain. The cuticle, or grain, is composed of a number of minute polygonal cells, those of the inner surface being the most per fectly formed and filled with fluid; while as we proceed outwards they become flattened and irregular, and, finally, at the outer surface are mere scales, easily to be detached. The true skin, or flesh, is mainly composed of a net-like tissue of nerves and blood-vessels, the interstices being filled up with gelatine.

The first part of the process of preparing the skin for the tan liquor, consists in removing the hairs and fatty matter it contains; when this is done, it is in a very flaccid state, the fibres loosely interlaced with each other. As the tannin combines with the gelatine, the newly formed tannate of gelatine, or leather, occupies a greater space than the original gelatine, and diminishes the porosity of the skin; thus it is that the tan liquor is found to have penetrated during the first six or seven days more than half way to the middle of a skin, which at the end of above two months is not acted upon completely to the centre. This constitutes the great practical difficulty of tanning; the surfaces become overtanned before the middle is acted upon at all, while it remains, in fact, still in the condition of raw hide. The greater this irregularity, the worse is the quality of the article produced. Nor is this the only evil; for instead of an increase of nearly 80 per cent., which should take place if the process were conducted in the most perfect manner, it is found, practically, that not more than from 20 to 40 per cent. of weight is usually added. This arises from the tanno-gelatine or leather, formed on the surface, being dissolved by the solution, while the skin is soaking in it to allow its penetration to the interior. This source of waste is accompanied by another, viz., the decomposition of the tan liquor, the tannin being converted into gallic acid, which though very similar in most of its properties, is incapable of combining with the gelatine and forming leather. This is probably the agent which dissolves the leather.

Many attempts have been made to overcome these difficulties, such as passing the skin under rollers to press the old liquor out and admit fresh; but this is found not only to press out the spent liquor, but the loose gelatine from between the fibres also. Thus, although the process is accelerated, a lighter and inferior article is produced; and as the tanner buys his skins, and sells the manufacfactured leather, by weight, this loss of weight is more than a set off against the time gained, independently of the depreciation of quality. Hydraulic pressure has been applied; the skins have been sewn together to form bags, and filled with liquor, which by its own pressure, or with the additional pressure of a column of fluid, has been forced through the skin, and the tanning has taken place with extreme rapidity; but here the gelatine has been forced through in such quantities as to hang in large slimy masses outside the bags, and thus has this method like the other been abandoned. Other methods of applying pressure have been adopted, but all with the same result; any degree of violence of this kind is always accompanied with a loss of gelatine.

Exhaustion by the air-pump, on the same principle as Kyan's patent for saturating wood with corrosive sublimate, has been tried; but this is quite valueless in practice, since the skins require to have passed through them many times their bulk of solution; and thus the operation must be very frequently repeated, and the skins dried between each

application of the vacuum, so that the expense of applying this system would swallow up all the profits, and a considerable deal more.

Mr. Snyder's method is extremely simple, and open to none of these objections. It consists of making a large number of fine punctures in the skin, either partly or completely through it, which admits the liquor at once by capilliary attraction to immediate contact with a vastly greater surface, and fairly to the centre of the skin. Thus it is tanned more equally throughout, and in less than half the time required by the ordinary process; a much better article is produced, a great saving of material is effected, and a far greater weight of leather obtained from the same quantity of skin. We believe that the extra profits thus arising are rather under than overrated, when estimated to amount to 30 per cent., which, if the capital be turned three or four times per annum, becomes a matter of some consideration for the shareholders.

It appears at first sight a rather bold experiment to perforate a skin throughout in order to make it ultimately more compact and impervious, but it has nevertheless succeeded; for the punctures heal completely on the fleshy side of the skin, (generally about three-fourths of the whole thickness,) though they remain open and visible in the grain.

This healing is so complete that no traces of the punctures are visible on cutting through the flesh, even when examined with the aid of the strongest magnifier; nor is their existence made manifest by pressure of either air or water. It appears that the points used in puncturing only penetrate between the fibres and separate them temporarily; and this being done when they are in the loose, flaccid state, before described, it is easy to understand that when they are thickened by the combination with the tannin, and the intervening gelatine is expanded, the space they occupied must be completely filled with the newly formed leather. This view of the *rationale* of the process is strengthened by the fact that the punctures remain in the grain, which is not fibrous at all, and hence the filling up cannot take place, the cells and scales being ruptured or perforated by the punctures.

These punctures which remain in the grain, so far from injuring the leather, are highly advantageous, the grain being under ordinary circumstances liable to draw, that is, to present a wrinkled appearance, owing to its expanding unequally with the flesh. It is in this drawn grain that the cracking of leather begins, and on this account the splitting of leather, (that is, the entire removal of the grain,) and in other cases the shaving away of the grain from those parts of the boot most like to crack, has been adopted with great success.

An important characteristic of this invention is, that it can be applied in conjunction with any other improvement that may hereafter be made, either in the composition of the solution or the mode of applying it. Thus punctured skins may be tanned in two or three days, or even in a few hours, by sewing them up into bags and applying pressure; but for reasons before stated this is not advisable, the quality being inferior in proportion to the acceleration thus attained; for besides the loss of gelatine the skins are not completely tanned, but only coloured by the solution passing through them, and thus the currier may be deceived and a serious loss entailed upon him.

Mr. Snyder is a practical tanner, who has been engaged all his life working at his trade. We mention this as an illustration of the importance of practical men turning their attention to the improvement of the arts in which they are engaged; for when we recollect that Sir Humphrey Davy devoted two years to the subject of tanning, we cannot but be struck with the fact, that this simple, and we may say unscientific, idea of making holes to admit the liquor, is likely to do far more for the practical improvement of this important branch of manufacture, than all the elaborate and skilful researches of the great philosopher, interesting and valuable as they are as contributions to pure science.

THE AIR STREAMS OF THE PUNA, IN PERU.—THE PRESSURE OF FLUIDS *NOT* THE SAME IN ALL DIRECTIONS.

Sir,—It has often appeared to me, that readers of voyages and travels would confer a very great benefit on science by contributing towards a wider diffusion of those natural phenomena so frequently

mentioned in them, and which, if not thus brought forward in scientific periodicals, may remain unnoticed by any but the comparatively few readers of the book of travels or voyage itself. The number of such books is so enormous, that no one reader can become acquainted with any but a small proportion; and if he were to set to work, to search for such casual notices of phenomena, he might spend his whole life, and not get half through his task. And yet, several of the most beautiful illustrations we have of natural laws, have been thus discovered by intelligent travellers. Now, if every reader of such works, who is sufficiently interested in science, to notice these widely scattered, though valuable observations, would contribute an account or reference to some scientific periodical, we should soon have a fund of most interesting and really valuable matter.

The following extract is from an extremely interesting book of travels in Peru, by J. J. Von Tschudi, published in 1846, and, I believe, not yet translated from the German—the extract made being from a notice of it in the *Foreign Quarterly and Westminster Review.* The "Puna," to which region the author is referring, are the plains lying between the Andes and Cordilleras, at a height of 12,000 feet above the level of the sea; and, from the latter range of mountains, cold winds "sweep over the plain, regularly accompanied for four months with daily violent snow-storms:"

"It often happens that the traveller passes suddenly out of these cold winds into very warm currents of air, which are sometimes two or three feet, oftener several hundred feet wide, and occur in parallel lines at repeated intervals, so that one may pass through five or six of them in the course of a few hours. I found them particularly frequent in the months of August and September, in the highland plains between Chacapalpa and Huancavelica. As far as my repeated observations extend, the general direction of these currents is the same as that of the Cordillera, namely, S. S. W. and N. N. E. My course once led me for several hours longitudinally through one of these warm streams of air, which was not more than seven-and-twenty paces wide. Its temperature was 11° R. (about 25° Fah.) higher than that of the contiguous atmosphere. It appears that these streams are not merely temporary; for the arrieros often predict with great accuracy where they will be encountered; nor are they to be confounded with the warm air of narrow, rocky ravines, since they extend over the open plain. The cause of this curious phenomena is well deserving of minute inquiry by meteorologists."

Here is another, in addition to thousands of proofs, of the truth that "l'equilibre des températures est un fait du cabinet," as Boutigny says. The reluctance to believe in this and similar facts—namely, that different masses of air or water may pass through each other freely, whilst each preserves, almost unaltered, its own peculiar temperature (which may be a score or two of degrees higher in one than the other)—is very great, and nothing but a host of well-ascertained instances, such as the high temperature of the gulf stream above the surrounding water, and such sudden variations in the temperatures of contiguous masses of air as those just recorded,—nothing but abundance of these facts, will suffice to destroy the old notions about "equilibrium of temperatures." And not only do these notions with regard to the communication of heat, require remodelling in accordance with the realities of nature, but everything connected with the communication of pressure or motion from one moving portion of air or water to another, requires a thorough re-examination with reference to facts.

There are plenty of facts, which prove incontestably, that the pressure of fluids in motion is *not* the same in all directions. Any mathematical calculations proceeding on such a supposition, can only be of use so far as the deviation form the law of equal pressure is found to be small: where the velocity of a stream of water, or river, is not great, for instance. But there are some investigations (I refer to those connected with the theory of light) in which a just appreciation of the fact that, so far as we can judge by observation of those elastic systems (such as air) which we can examine, the supposition of equal pressure in all directions, becomes more and more untrue, the greater the velocity of the motion, would tend very considerably to alter present views, and do away with a great mass of difficulty, having no other foundation than our own partial and unnatural suppositions and assumptions.

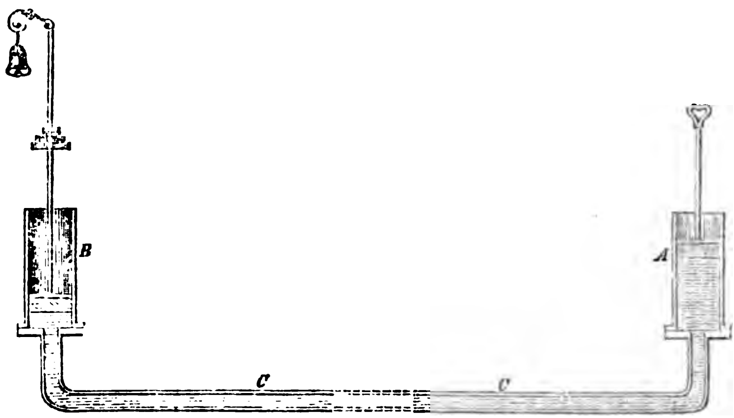
I shall, perhaps, take another opportunity of referring to this question—at

present referring those who feel interested in it to a very *suggestive* note appended to the last memoir of that greatest of living mathematicians, Poisson, in the "Mémoires de l'Academie des Sciences," tome xviii.

The German traveller gives an amusing account of the consequences of the want of knowledge in the inhabitants of these lofty plains. "Water boils at so low a temperature in the high regions, that potatoes and meat cannot be made soft by twenty-four hours' boiling. The Indians have no suspicion of the real cause of the phenomenon, and ludicrously find fault with the vessel, or with the pasture, or the age of the animal whose flesh defies cooking. Even the better class of Peruvians exhaust themselves in conjectures on the subject: and our author knew a parish priest who had sheep fetched from the low valleys, thinking their mutton would be more easily boiled."

A. H.

THE HYDRAULIC TELEGRAPH INVENTED BY BRAMAH FIFTY YEARS AGO.



Sir,—I see, in your Number for March 25th, you trace the hydraulic telegraph only twenty years back. It happens, however, that the very arrangement suggested by M. Jobard was patented in this country by the celebrated Joseph Bramah, March 31, 1796, being above half a century ago. In the specification descriptive of his celebrated hydraulic press, Bramah gives an account of the following, as fig. 3 in his drawings:—

"This," he says, "is a section, merely to show how the power and motion of one machine may, by means of fluids, be transferred or communicated to another, let their distance and local situation be what they may. A and B are two small cylinders, smooth and cylindrical, in the inside of each of which is a piston, made water and air-tight; CC is a tube conveyed underground, or otherways, from the bottom of one cylinder to the other, to form a communication between them, notwithstanding their distance be ever so great, this tube being filled with water or other fluid, until it touch the bottom of each piston; then, by depressing the piston A, the piston B will be raised. The same effect will be produced, *vice versâ;* thus, bells may be rung, wheels turned, or other machinery put invisibly in motion, by a power being applied to either."

Bramah gives another figure, on the same principle, "of a means of communicating the action and force of one machine to another," by all which your correspondent is fully anticipated in his views. Further comment must be needless. The arrangement of bells, scales, and machines to be worked by this means, are obvious; these may be improved, but the great principle of the invention itself remains as Bramah devised it. I am, Sir, yours, &c.,

London, March 27, 1848. INVESTIGATOR.

FIRST REPORT ON THE COALS SUITED TO THE STEAM NAVY. BY SIR HENRY DE LA BECHE AND DR. LYON PLAYFAIR.

(Continued from page 309.)

With regard to the selection of the coals for trial, we have to refer to Mr. Wilson's letter, inserted in the Appendix. This letter gives the information obtained in a tour made by Professor Wilson for the purpose of ascertaining the best coals fitted for trial in the South Wales coal district, and the ports from which they can conveniently be

TABLE II.—*Showing the Economic Values of the Coals.*

	Names of Coals employed in the Experiments.	Economic evaporating power, or number of pounds of Water evaporated from 212° by 1 lb. of Coal.	Weight of 1 cubic foot of the Coal as used for fuel — Lbs.	Weight of 1 cubic foot as calculated from the density. — Lbs.	Ratio of B. to C. or of the economical to the theoretical weight.	Difference per cent. between theoretical and economical weights.	Space occupied by 1 ton in cubic feet (economic weight).	Results of experiments on cohesive power of Coals per centage of large Coals.	Evaporating power of the Coal after deducting for the combustible matter in the residue.	Weight of Water evaporated from 212° by 1 cubic foot of Coal.	Rate of evaporation, or number of lbs. of Water evaporated per hour. — Mean.
		A.	B.	C.	D.	E.	F.	G.	H.	I.	
Welsh Coals.	Graigola	9·35	60·166	81·107	·742	34·8	37·23	49·3	9·66	581·20	441·48
	Anthracite, Jones and Co.	9·46	58·25	85·786	·679	47·26	38·45	63·5	9·7	565·02	409·87
	Old Castle Fiery Vein	8·94	50·916	80·42	·633	57·946	43·99	57·7	...	455·18	464·30
	Ward's Fiery Vein	9·40	57·433	83·85	·685	46·	39·	46·5	10·6	608·78	529·90
	Binea	9·94	57·08	81·357	·702	42·53	39·24	51·2	10·3	587·92	486·25
	Llangennech	8·86	56·93	81·85	·695	43·76	39·34	53·5	9·2	523·75	373·22
	Pentrepoth	8·72	57·72	81·73	·705	40·17	38·80	46·5	8·98	518·32	381·50
	Pentrefelin	6·36	66·166	84·726	·781	28·051	33·85	52·7	7·4	489·62	247·24
	Duffryn	10·14	53·22	82·72	·643	35·43	42·09	56·2	11·80	540·12	409·32
	Mynydd Newydd	9·52	56·33	81·73	·689	45·09	39·76	53·7	10·59	536·26	470·69
	Three-quarter Rock Vein	8·84	56·388	83·60	·674	48·26	39·72	52·7	...	498·46	486·86
	Cwm Frood Rock Vein	8·70	55·277	78·299	·706	41·648	40·52	72·5	9·35	480 90	379·80
	Cwm Nanty-gros	8·42	56·0	79·859	·701	42·60	40·00	55·7	8·82	471·52	404·18
	Resolven	9·53	58.66	82·354	·712	40·39	38·19	35·0	10·44	559·02	390·25
	Pontypool	7·47	55·7	82·35	·676	47·845	40·216	57·5	8·04	416·07	250·40
	Bedwas	9·79	50·5	82·6	·611	63·565	44·32	54·0	9·99	494·39	476 96
	Ebbw Vale	10·21	53·3	78·81	·676	45·98	42·26	45·0	10·64	544·19	460·22
	Porth-mawr	7·53	53·3	86·722	·614	62·7	42·02	62·0	7·75	401·34	347·44
	Coleshill	8.0	53·0	80·483	·658	51·85	42·26	62·	8·34	424·0	406·41
Scotch Coals.	Dalkeith Jewel Seam	7·08	49·8	79·672	·625	59·984	44·98	85·7	7·10	352·58	355·18
	,, Coronation Seam	7·71	51·66	78·611	·657	52·17	43·36	88·2	7·86	398·29	370·08
	Wallsend Elgin	8·46	54 6	78·611	·694	43·78	41·02	64·	8·67	460·82	435·77
	Fordel Splint	7·56	55·0	78·611	·699	42·92	40·72	63·	7·69	415·80	464·98
	Grangemouth	7·40	54·25	80·48	·674	48·35	40·13	69·7	7·91	401·45	380·40
English Coals.	Broomhill	7·3	52·5	77·988	·673	48·55	42·67	65·7	7·66	383·25	397·78
	Lydney (Forest of Dean)	8·52	54·444	80·046	·68	47·02	41·14	55·0	8·98	463·86	487·19
	Slievardagh Irish Anthracite	9·85	62·8	99·57	·630	58·55	35·66	74·	10·49	618·58	473·18
Patent Coals.	Wylam's Patent Fuel	8·92	65·08	68·629	·948.	5·45	34·41	...	9·74	580·51	418·89
	Bell's ,,	8·53	65·3	71·124	·918	8·91	34·30	...	8·65	557·0	549·11
	Warlich's ,,	10·36	69·05	72·248	955	4·49	32·44	...	10·60	715·85	457·84

shipped. This district was selected because the varying character of the coals, from the bituminous to the anthracitic, offered those which were most likely to combine the qualities desired for naval purposes. It was intended, as being most convenient for the inquiry, to have adhered strictly to districts. In the experiments this has hitherto been done, except in special cases, at the request of the Admiralty.

Table II. contains an abstract of the results, so far as regards the evaporative value of the fuel; the special characters of each of the coals being described in the experiments detailed in the Appendix.

This Table relates only to the economical value of the coals examined, and to the steam generated by a unit of the respective coals, without, however, implying a unit of time. The details with reference to time, which forms a most important element in the value of the respective fuels, will be found in section II.

TABLE III.—*Showing the Mean Composition of average samples of the Coals.*

	Locality or name of Coal.	Specific Gravity of Coals.	Carbon	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ash.	Per centage of Coke left by each Coal.
Welsh Coals.	Graigola	1·30	84·87	3·84	0·41	0·45	7·19	3·24	85·5
	Anthracite	1·375	91·44	3·46	0·21	0·79	2·58	1·52	92·9
	Oldcastle Fiery Vein	1·289	87·68	4·89	1·31	0·09	3·39	2·64	79·2
	Ward's Fiery Vein	1·344	87·87	3·93	2·02	0·83	Included in ash.	7·04	...
	Binea Coal	1·304	88·66	4·63	1·43	0·33	1·03	3·96	88·10
	Llangennech	1·312	85·46	4·20	1·07	0·29	2·44	6·54	83·69
	Pentrepoth	1·31	88·72	4·50	0·18	...	3·24	3·36	82·5
	Pentrefelin	1·358	85·52	3·72	Trace.	0·12	4·55	6·09	85·0
	Duffryn	1·326	88·26	4·66	1·45	1·77	0·60	3·26	84·3
	Mynydd Newydd	1·31	84·71	5·76	1·56	1·21	3·52	3·24	74·8
	Three-quarter Rock Vein	1·34	75·15	4·93	1·07	2·85	5·04	10·96	62·5
	Cwm Frood Rock Vein	1·255	82·25	5·64	1·11	1·22	3·53	6·00	68·2
	Cwm Nanty-gros	1·28	78·36	5·59	1·86	3·01	5·58	5·60	65·6
	Resolven	1·32	79·33	4·75	1·38	5·07	Included in ash.	9·41	83·9
	Pontypool	1·32	80·70	5·66	1·35	2·39	4·38	5·52	64·0
	Bedwas	1·32	80·61	6·01	1·44	3·50	1·50	6·94	71·7
	Ebbw Vale	1·275	89·78	5·15	2·16	1·02	0·39	1·50	77·5
	Porth-mawr Rock Vein	1·39	74·70	4·79	1·28	0·91	3·60	14·72	63·1
	Coleshill	1.29	73·84	5·14	1·47	2·34	8·29	8·92	56·0
Scotch Coals.	Dalkeith Jewel Seam	1·277	74·55	5·14	0·10	0·33	15·51	4·37	49·6
	,, Coronation Seam	1·316	76·94	5·20	Trace.	0·38	14·37	3·10	58·5
	Wallsend Elgin	1·20	76·09	5·22	1·41	1·53	5·05	10·70	58·45
	Fordel Splint	1·25	79·58	5·50	1·13	1·46	8·33	4·00	52·03
	Grangemouth	1·29	79·85	5·28	1·35	1·42	8·58	3·52	56·6
English Coals.	Broomhill	1·25	81·70	6·17	1·84	2·85	4·37	3·07	59·2
	Park End, Lydney	1·283	73·52	5·69	2·04	2·27	6·48	10·00	57·8
	Slievardagh (Irish)	1·59	80·03	2·30	0·23	6·76	Included in ash.	10·80	90·1
Foreign Coals.	Formosa Island	1·24	78·26	5·70	0·64	0·49	10·95	3·96	...
	Borneo (Labuan kind)	1·28	64·52	4·74	0·80	1·45	20·75	7·74	...
	,, 3 feet seam	1·37	54·31	5·03	0·98	1·14	24·22	14·32	...
	,, 11 feet seam	1·21	70·33	5·41	0·67	1·17	19·19	3·23	...
Patent Fuel.	Wylam's Patent Fuel	1·10	79·91	5·69	1·68	1·25	6·63	4·84	65·8
	Bell's ,, ,,	1·14	87·88	5·22	0·81	0·71	0·42	4·96	71·7
	Warlich ,, ,,	1·15	90·02	5·56	Trace.	1·62	Included in ash.	2·91	86·1

The economical results obtained by evaporation, in the best applied practice, are ascertained to be only a small part of the theoretical result following from the actual quantity of heat capable of being generated. Still, as a comparative statement, it is necessary to contrast the economical heat given out by a coal with the theoretical quantity. The cause of the difference between the applied and theoretical quantities is, at least in a great degree, obvious, and does not by the apparent difference prove the fallacy of calculation. Before the comparison can be made, it is necessary to have a knowledge of the composition of the respective coals; of this we subjoin a Table, reduced from section IV.

(*To be continued.*)

STIVEN'S IMPROVED SHUTTLE FOR POWER-LOOM WEAVING.

[Registered under the Act for the Protection of Articles of Utility. Richard Stiven, of Arbroath, Warehouseman, Inventor and Proprietor.]

Fig. 1.

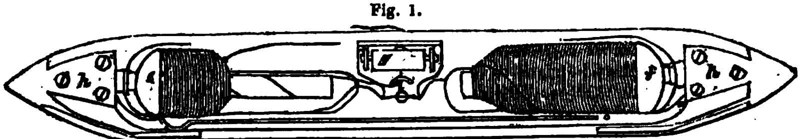


Fig. 2

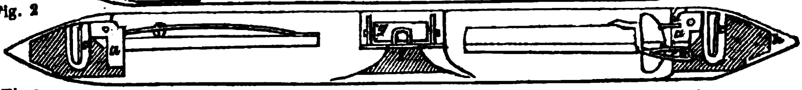


Fig. 3.

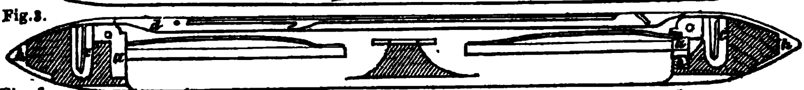


Fig. 6.

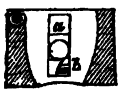
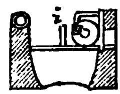


Fig 7.



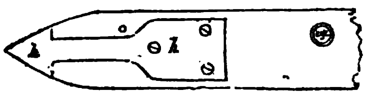


Fig. 4.

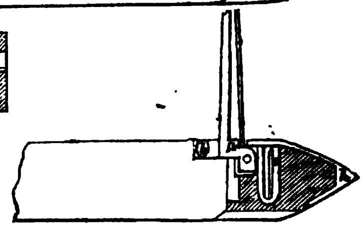


Fig. 5.

The shuttles most commonly used in power looms, have but one pirn or spindle, and are capable of producing about eight inches only of cloth without stoppage. Mr. Stiven employs two pirns, and informs us that he can by this means throw off with ease thirty inches without stopping. We think we have heard of two-pirned shuttles before, but, from their never having come into general use, we conclude that they cannot have been of so efficient a construction as that which we now present to the notice of our readers. Another valuable feature of this improved shuttle is, that it makes two perfectly equal selvages.

Fig. 1 is a top plan of the instrument (which is made of wood), and figs. 2 and 3 are longitudinal sections of it; *e* and *f* are two pirns, or spindles, facing each other, and placed on the tongues, *aa*. To these tongues springs are attached, to give the pirns a firm hold. The thread on the one pirn, *e*, is connected with that of the pirn *f*, along the tube *d*, so that when the thread of one pirn is exhausted, the thread runs instantly to the other pirn, from which it is thrown off continuously, without a stoppage of the machine, until both pirns are run out—an exceedingly ingenious arrangement.

For the purpose of selvaging, the friction-roller, *g*, is placed within the shuttle, the thread being drawn under the roller, and out of the shuttle through the eye in the centre, as shown separately in fig. 4. The eye, *i*, adjoining the roller in figs. 1 and 2, is for conducting the thread to the centre of the roller. The parts marked *hhh* are formed of iron, pointed with steel, and are intended to strengthen the shuttle, and to allow the square interior portion of it to be opened up for use. The pirn is secured to the shuttle not only by means of the springed tongue, but also by a wire passing through the head of the pirn, and fixed to the stud, *bb*, the stud itself being shown separately in fig. 6, *b*, which is a transverse section of the shuttle at that place. In order to get the pirn put upon the tongue, the latter is made to open up, as shown in fig. 4. This is done by means of the spring, C, which, again, when the tongue and pirn are folded into the shuttle, keeps both securely fastened in the position proper for use.

Fig. 7 is a transverse section of the centre portion of the shuttle, showing the roller, the wire by which it is kept in its place, and the eye, shown in fig. 1.

OBSERVATIONS ON THE COMPARATIVE ADVANTAGES OF GEOMETRICAL AND ANALYTICAL STUDIES.

Sir,—In the last number but one of this Magazine, the opinion expressed in the "Note by an Ex-Reviewer" has led me to the reflections which I now venture to send you. Having reason to believe that the opinions expressed in that "Note" are those of one who is at least as well qualified as any other mathematician in England, to pronounce judgment on any matter connected with the study of geometry, I cannot but attach considerable weight to any opinion thus expressed, and which it is not in any way the object of these remarks to controvert. An examination, however, into the nature and distinguishing features of these two branches of mathematical science, independently of its intrinsic interest, has results of great importance in an educational point of view. The writer of the "Note" referred to would, introduce geometrical studies much more freely into the Cambridge course of reading; and it is well known to the readers of the non-academical mathematical works and periodicals, that a very strong predilection exists amongst that portion of British mathematicians for the "Ancient Geometry" as distinguished from "Modern Analysis."

The usual motives and reasons alleged for such preference are too well known to need any detailed account. The object which a person has in view in applying to mathematics, will of course very greatly influence him in determining the department to which he will devote himself. He whose aim it is to become acquainted with physical science —with optics, or mechanics, or astronomy, &c.—will very soon become a decided partisan of analysis, from its immeasurable superiority over geometry in all physical inquiries. This superiority no one who knows anything at all about mathematics will even for one moment dispute. But, supposing his object to be simply intellectual exercise, as it is with perhaps the greater number, at any rate of non-university men, there must be some other grounds for his choice. What is there to decide him whether he shall devote himself to researches in the theory of equations, in integration, &c. &c., or whether, on the other hand, to geometrical porisms, &c.? Perhaps no one has ever deliberately sat down to consider beforehand which of these two branches he will cultivate. The choice is, no doubt, in most cases, insensibly formed and acted upon. There are one or two grounds for such a decision, which are very obvious, and worth inquiring into.

The first book of mathematics which a boy in this country gets hold of, is Euclid; (I leave arithmetic out of the question, according to the ancient and approved phraseology of all school-prospectuses, in which it is professed that "arithmetic *and* mathematics" are there taught; nor is the distinction in such cases a groundless one, if by "mathematics" be meant anything by which the reasoning faculties are exercised.) Now, in Euclid, when once the few terms, "angle," &c., are understood, and a dozen or twenty propositions gone through, the remainder may be easily comprehended by any boy of average ability, without any assistance whatever; and of this ease one great cause is the fact that he can see beforehand what he is driving at; the enunciation of the proposition puts at once clearly before him the aim and object of all the subsequent reasoning. This reasoning, moreover, is carried on by the ordinary everyday language—and, lastly, the evidence afforded to the senses by a well-drawn or printed diagram, is by no means the least effective portion of the machinery used to produce a conviction of the truth of the proposition. Compare all this now with algebra, or any other branch of analysis. In nearly every point of comparison, the directly opposite to the above features is found. No direct proposition is enunciated to begin with, no end or object is in view, and the reasoning is conducted in a language strange and mystical. Even after a good deal has been learnt and considerable familiarity acquired in the use of this language, the student still finds himself sadly in the dark as to what he is really about: he is like a person standing by whilst a watch, or some other complicated machinery, is being put together. As each part is brought forward and introduced into the series of wheels, pinions, &c., he cannot see exactly why it is introduced, nor what ultimate purpose it is destined to serve, *i. e.*, sup-

posing him never to have seen a watch put together before. It appears to him a proceeding devoid of either definite aim or sufficient motive. Very probably he sees that this wheel or spring has a great many properties, and *may* produce a great number of different effects, all of which are jumbled together in his mind, and its action on the surrounding parts is utterly lost to his view through the immense variety of *possible* actions, or results which are floating in his mind. In the midst of this confused jumble of all possible and conceivable results, *the* result which *will* ensue when the whole is complete, that which alone the watchmaker intends to produce, *this*, I say, is not more thought of by him than any of the other possible results. It is not at all distinguished in his eyes from them. If left to himself to speculate on the effect which all this mechanism, so far as it is carried, will produce, he knows not on which one in particular to fix:—he is perplexed by their multiplicity. In following out a train of algebraical reasoning, precisely similar perplexity is felt. Why this or that line occurs—to what end one equation is introduced, or why out of all its possible consequences only one is chosen—he cannot imagine. Or, to take another illustration—we may compare him to a person travelling under the guidance of another along a succession of continually intersecting cross-roads. His guide is tending all the while to one given point. Every turn he takes is with a determinate view. There may be no direct road to the place they want to reach, and all this twisting and turning is absolutely necessary to get there at all. But the traveller, pursuing this course for the first time, is thoroughly bewildered. At each turn he is at a loss to know why they did not go to the right rather than the left, or straight on, rather than turn off at all. He sees an indefinite choice before him—but which of them all is the one leading to the desired point he sees not, even supposing him to have such a definite point before him at all—which the student generally has not.

This is, indeed, one of the chief and most vexatious of the difficulties in the reading of most mathematical processes, and is perhaps felt more, or at least as much, in such parts as analytical dynamics, &c., as in the lower or more elementary ones. A certain path being entered upon, he hardly knows why, is pursued only for a short distance, and then another struck into, for equally mysterious reasons. The more cautious and attentive he is to what he is doing, the more uncertainty and anxiety he feels. In contemplating all possible results of one part of the machinery, it naturally occurs to him, at first, that some of these results may counteract and destroy those of other parts. When a result depends on several conditions, he is anxious to see whether he has got in any case *all* these conditions, or if he has *more* than these; because if so, these new conditions may interfere with the others, and destroy the whole foundation on which his reasoning depends.

When a man has once seen the watch put together, on running his eye over the train of wheel-work, &c., he is now able to fix on the particular effect of each part which is brought into play: he throws aside all those other possible results of that part which formerly bothered him. Each wheel or spring, &c., *may* be producing innumerable results of all conceivable kinds, but he now perceives at once which are irrelevant, and have really nothing to do with the ultimate object in view. Or, if we make use of the other illustration: in going over the road a second time, he is no longer at a loss at each turn, because he has clearly before him, "in his mind's eye," the place at which he wants to arrive, and the successive steps necessary to be taken for that purpose. Thus the mathematical student, on going through his course a second time, finds the reason for each step of the process—the object to be gained by going on such a road rather than another, and for stopping at a certain point on that road to branch off into another.

I believe it is almost always the case, that those who do not begin their algebraical studies until grown up—that all, in fact, who wish to *understand* fully every step, and to have a distinct reason for each portion of the mechanical process they are called upon to perform—that these sort of learners are precisely those who are most disconcerted and perplexed. A schoolboy sees no more than they do, but he is far less apt to conjure up imaginary difficulties, as well as to

observe real ones. I knew a gentleman of more than the average abilities, (a barrister,) who had a great desire to learn mathematics; and the difficulties he *manufactured* in the first four "rules" of algebra—the bugbears he conjured up—the mystical visions he had of disembodied symbols—were truly wonderful. I believe, at one time, his notions of such "unknown quantities" as x, y, z, were, that they were a species of occult qualities. Bishop Berkeley called "second differentials" "*the ghosts of departed quantities*," and this gentleman evidently looked with an equally suspicious eye on even x, y, z. They were not tangible enough for his lawyer-ideas; there was no seizing them. But even schoolboys get odd notions of these matters. I can remember very well, that whenever the phrase occurred, "Let so and so (the algebraical expression $a+b+c$, or any other) equal x," it appeared to me a downright, barefaced, and most unwarrantable *assumption* to make. I had got the notion that the symbol x meant some one given, definite, unalterable thing or other, which could no more be *made equal* to another thing $(a+b+c)$ taken at random, and of just as fixed and unalterable a nature, than we could make two equal to five. And this same difficulty I have observed in others. One laughs at such things afterwards; but we should not stop there. The difficulties experienced by beginners in any science (when they are not the effects of mere laziness) are almost always worthy of the most careful study by the more advanced in that science. The same *causes* of error—though not the same errors—are constantly at work. The most profound analyst may be, and often has been, either perplexed or led into actual mistake, through the operation of the very same causes of mental confusion which have produced the laughable blunders of the schoolboy. The most prolific source of such confusion is, the nature of language itself—both common language and symbolical. The neglecting to attach a definite and distinct idea to each word or symbol—the using one such idea for another, and confounding the results obtained by reasoning upon the one with those obtained by reasoning upon the other—these are eternally active sources of error in the reasonings of all kinds of science, mathematical or moral. Take, for instance, the word "value" in political economy, or the symbol $=$ in mathematics.

Now, inasmuch as geometry is free from all such embarrassing circumstances, it is immeasurably superior to all other branches of scientific study as a means of initiating the beginner into habits of strict and clear reasoning, and supplies him with examples of such reasoning which could be found nowhere else. It requires nothing but patient attention to the successive steps in the demonstration, so as to perceive that each really is a necessary consequence of the preceding. There is no confusion or vague notions floating constantly before the mind as to *what is meant*, as in algebra or other parts of mathematics. There is no complexity of conditions, and uncertainty as to fundamental assumptions, as in the application of mathematics to physics. This confusion and these uncertainties, which are constantly tormenting the beginner in one case, have no existence in the study of geometry. So far, then, it may be called the easiest of all sciences; not that it is easier to confine the attention to a demonstration in Euclid than to one in algebra or the differential calculus of equal length, *provided* each step in the one were as clear as in the other, but precisely because this proviso is not verified.

If we now consider the nature of the difficulties in algebra, and which render it impossible to give a boy (or any other beginner) clear notions of the reasoning until he has acquired a good deal of mechanical familiarity with it, it will be seen that they partake more of the nature of those difficulties which are encountered in the study of such things as political economy, or in the arguments of every-day life: they are difficulties, *not* in following out step by step a train of straightforward reasoning, but in attaching clear ideas to words and symbols, in taking into account all necessary conditions, and putting aside all unnecessary ones; in selecting from a variety of *possible* results that one which alone is of any influence on the point we are considering; and in a careful remembering, throughout the whole argument, of the assumptions or suppositions made at its commencement. The merely mechanical part of algebra requires, perhaps, less thought than many manual occupations: the clear and distinct insight into the full

meaning and rational process thus symbolically carried on, requires in most cases a far higher effort than anything geometry demands, and may afford a mental discipline as valuable in some respects, and far more so in others. You might almost teach a cat to differentiate and integrate "in six lessons," whilst very few rational beings ever arrive at a clear comprehension of the real nature and principles of the differential and integral calculus in less than six years. Babbage's machine can work away at finite differences with as much accuracy as any man; but the united labours of mathematicians for centuries may be unequal to the task of tracing out all the consequences or real principles involved in its simplest theorems. All this purely mechanical work, however, must be gone through before any rational view of the real signification of what he has been doing can be attained by the learner. I have no faith in those ultra-philosophical schemes, so rife now-a-days, for making a child see through an inch board by one of your newly-patented processes. I have a great deal of faith, however, in the possibility of giving a much more satisfactory and philosophical insight into these matters *after this necessary preliminary labour has been gone through*, than any which the ordinary run of students ever obtain; and the very efforts necessary to this end I cannot but consider as quite as valuable as any required in the study of geometry—indeed, in many respects, as much more valuable. The reason that so few engage in this sort of investigation into the principles of algebra, or analytical reasoning generally, is simply its very great difficulty. And yet the inducements to such an examination are of no ordinary weight. Let us advert, in the first place, to those inducements arising from the intrinsic interest of the subject itself. It is well known to every one at all advanced in such studies, that the most curious and paradoxical results are met with everywhere, and that often apparently sheer mysticism or downright impossibility leads to plain and evident truth. A. H.

(To be concluded in our next.)

GUTTA PERCHA PATENTS.—NO. IX.*

Charles Hancock, *of Brompton, Gentleman, for "Improvements in the Preparation of Gutta Percha, and in the Application thereof, alone and in Combination with other Materials, to various Manufacturing Purposes."* Patent dated Sept. 24, 1847; Specification enrolled March 24, 1848.

My invention consists, *firstly*, in certain modes of preparing and treating gutta percha, alone and in combination with other materials, for manufacturing purposes, by means of baths, which enable me with advantage to obtain higher and wider ranges of temperature for that purpose, than has been hitherto attainable by the use of water only; and also, in some cases, kneading, manipulating, and otherwise manufacturing the simple or compound material, and in some cases also subjecting it to the action of a chemical agent. For temperatures a little above that of boiling water, I employ a solution, saturated or nearly so, of some alkaline salt or earth, or any other soluble substance which will increase the density of the water and elevate its boiling point, such as carbonate of potash, carbonate of soda, or muriate of lime, or any other soluble salt which will not act prejudicially upon the material; selecting more soluble salts or substances in those cases in which it may be desired to subject the material to higher degrees of temperature. For higher temperatures, I make use of fixed oils, fats, wax, or similar materials, or of any of the well-known fusible metallic alloys; and for the purposes of such baths, any other convenient and economical substance may be employed, the melting or boiling point of which is above the boiling point of water. And in cases where a liquid bath is not requisite, and a dry bath sufficient for the purpose of preparing the material in the intended manner, a bath of sand, or any similar substance, may be employed. The bath which I use in performing this part of my invention (of whichever of the aforesaid descriptions it may be), is to be heated by such of the ordinary means employed for the purpose as may be most convenient. When the bath-vessel is filled with any solution or melted substance which will not exert any injurious effect upon the material to be operated upon, and when the temperature is not raised beyond 300° of Fahrenheit, I immerse the gutta percha or compound

* For specifications of former patents, see *Mech. Mag.*, Nos. 1180, 1181, 1182, 1183, 1185, 1200, 1232, 1233, 1253.

in the bath, and keep it so immersed until the mass is thoroughly heated and brought to a soft, plastic, or fluid, or semi-fluid state, the degree of temperature to which the material is heated being more or less elevated, according to the purpose to which it is intended to be applied. When the temperature of the bath employed is so high, or the substance with which the bath-vessel is filled is of such a nature, as to act injuriously upon the gutta percha, alone or compounded, as aforesaid, I enclose it in a case, envelope, or vessel, so as to protect it from injury; and this case or envelope may be made of cloth, plaster of Paris, clay, glass, metal, or of such other substance as may be best adapted for protecting the material to be operated upon.

The vessel used for any of the aforesaid baths may be open or closed, and the contents may, if necessary, be subjected to pressure during the process of heating, and the vessels may be made of any shape or size which may be most convenient, according to the purpose to which it is intended to be applied.

The material or article to be operated upon, whether gutta percha or any of its compounds, and whether protected by a case or envelope or not, is to be kept in the bath in which it is placed for the time which may be requisite for producing the intended effect.

In some cases, I select such substances for baths as will produce a chemical action upon the gutta percha or any of its compounds, as caustic alkali, or a sulphuret of an alkali, or any other suitable sulphuret; and the temperature to which my baths enable me to raise those materials will, in many cases, cause the chemical agents to act more effectually, or with greater energy. If I wish to deprive gutta percha or any of its compounds of any acid with which it may be mixed, I boil it in a bath containing water, holding caustic potash, or soda, in solution, and of specific gravity 1010° or 1020°, saturated, or nearly so, with an alkali; and the temperature of such a bath at its boiling point being higher than that of water, the acid will be speedily and effectually separated from the material. The action of the bath upon the material may be increased or facilitated by agitating, kneading, or otherwise manipulating it during the process.

Secondly, my said invention consists of a method of manufacturing gutta percha or any of its compounds into vessels and hollow wares, or articles of various forms, by distending or expanding the material when in a soft, plastic state, by blowing or forcing air, or some other fluid, into a bag or piece of caoutchouc placed within the material of which any vessel or article is intended to be made, and at the same time (when necessary) subjecting the exterior parts of the material to the pressure, action, or operation of such moulds or other instruments as may be necessary to give the intended form, size, or pattern to the article into which the material is to be manufactured.

For the purpose of making any article in this way, I take a hollow piece of caoutchouc, preferring caoutchouc which has been rendered permanently elastic, of the size and shape which will be sufficient to enable me to distend or expand it in the requisite manner. This piece of caoutchouc I cover with a quantity of gutta percha, or of any of its compounds, sufficient to make the intended article; the outside of the piece of caoutchouc being first smeared with a little fat, soap, or some other thing which will enable me to detach it with facility from the interior of the article which is intended to be made.

The piece of gutta percha, or of any of its compounds, used in this way, may either be previously made into a cylinder, sack, or any other shape which may be convenient, and drawn over or placed upon the outside of the piece of caoutchouc; or the piece of caoutchouc may be covered with the requisite quantity of gutta percha, or of any of its compounds, in a plastic or sheet state, in any manner which may be most convenient.

The piece of caoutchouc being covered with the piece of gutta percha, or of any of its compounds, in the way already described, the orifice of it is to be attached by a ligature, or any other convenient means, to one end of a tube, through which air or any other fluid may be forced into the interior of the caoutchouc. The piece of gutta percha, or of any of its compounds, is then to be heated in a water alkaline bath, or by steam, or by any other convenient means, until it is brought into a soft, plastic state, and then air, water, or some other fluid convenient for that purpose, is to be blown or forced into the interior of the piece of caoutchouc, until the caoutchouc and its outside covering are distended or expanded to the required extent.

In cases where it is intended to make globular articles, and in some other cases, the blowing or forcing air, or some other fluid, into the interior of the materials, may be sufficient to produce the required effect, and make the article intended; but it will more frequently be necessary to employ some mould or other instrument to give the requisite form or pattern to the intended vessel or article.

If I intend to use a mould, I place the material, heated as already mentioned, within

the interior of the mould, and then proceed to distend the caoutchouc and the piece of gutta percha, or of any of its compounds, by air, or some other fluid, as aforesaid, until the piece of gutta percha, or of any of its compounds, is forced into every part of the mould, and by these means is formed into the shape and impressed with the form and pattern which the mould is intended to produce.

The article thus made is then to be kept in this distended state until it has become cool and firm, after which it is to be withdrawn from the mould, and the piece of caoutchouc drawn out of the inside of it. The orifice of the vessel or article made in this way, may then, if desired, be closed or trimmed in any manner which may be necessary to finish the article in the required manner.

The moulds to be used in performing this part of my invention may be of any size, form, or shape which may be convenient, and may be made capable of impressing the articles to be manufactured within them, with any pattern which may be desired; and these moulds may be constructed in a similar manner to glass-makers' moulds, or of any other construction or in any other manner which may be deemed most convenient.

In some cases, instead of using moulds, or in addition to using moulds, other instruments of a similar description may be used for giving shape or pattern to the exterior of the article intended to be made.

The piece of caoutchouc which I have described as placed within a piece of gutta percha, or of any of its compounds, which is intended to be made into any such vessel or article, as aforesaid, I use for the purpose of equalizing the internal pressure of the air or other fluid, by means of which the piece of gutta percha, or of any of its compounds, is to be distended into the required size and shape, or for rendering such pressure equal in every part of the interior of the article, and for preserving the article from injury, by the air or other fluid being forced through any part of the material to be made into a vessel or other article, as aforesaid. In some cases it may be desirable also to protect the outside of a piece of gutta percha, or of any of its compounds, which is intended to be made into any vessel or article, as aforesaid, before heating it or placing it in the mould; and in such cases I protect the material by a covering of caoutchouc, which will have the effect of keeping the material in its proper position upon the interior piece of caoutchouc whilst it is being heated in a bath, or by any other convenient means.

And, *thirdly*, my said invention consists of a mode or modes of hardening gutta percha, in order to render it more durable, and better adapted for bearing friction, or resisting the effects produced by exposure to the weather. For this purpose, I boil gutta percha for an hour or more in a bath containing a solution of caustic alkali, as before described, and knead the gutta percha therein at the same time with a wooden agitator, or otherwise, and mix with it a portion of the oxide of iron called colcothar, and of the oxide of lead called litharge, or of either of those oxides; and I believe that one part of either of those oxides, or of a combination of them with seven parts of gutta percha, or thereabouts, will be a useful proportion in which to mix the materials together.

The proportions of these materials may, however, be varied. I effect the admixture by introducing the intended quantity of both or either of these oxides into a masticating machine, in which I have previously placed the gutta percha, and then proceed to masticate the contents of the machine until the materials are thoroughly incorporated. I also add about ten per cent. of glue or bituminous matter, preferring it in powder, during the time of masticating the gutta percha for the purpose of increasing its tenacity and cohesion.

THE PRESENT STATE OF THE ART OF MOSAIC.

[From a paper by Digby Wyatt, Esq., architect, in the *Transactions of the Society of Arts*.]

On the revival of classical studies and Vitruvian systems, attention was naturally turned to the revival of some of the ancient arts. At Rome efforts were made to imitate the Opus Figlinum; at Florence, the Opus Sectile: both were crowned with success. The one is now known to us as Roman, the other as Florentine mosaic.

The study at Rome was doubtless much stimulated by the discoveries made there, from time to time, of various ancient examples, and it was to aid this object that the great Papal Mosaic Manufactory was established. As no change appears to have taken place in the mode of manufacture during the last 200 years, a short notice of the process now followed there may not be uninteresting. A plate, generally of metal, of the size of the picture to be copied, is first surrounded by a margin rising about three-quarters of an inch from its surface; this is then covered over with a coating of

perhaps a quarter of an inch in thickness of mastic cement, composed of powdered Travertine stone, lime, and linseed oil. This is, when set, entirely covered with plaster of Paris, rising to a level with the surrounding margin, which is intended to be exactly that of the finished Mosaic; on this is traced a very careful outline of the picture to be copied; and with a fine chisel just as much is removed from time to time, as will admit of the insertion of the little pieces of glass Mosaic, or, as the Italians call it, "smalto." This "smalto" is composed of glass, and is made in rounds, about six or eight inches in diameter and half an inch thick. The workman then proceeds to select from the great depository, wherein are preserved in trays nearly 10,000 varieties of colour, those he may require, which he then works to the necessary shape: this is done by striking the smalto with a sharp-edged hammer directly over a similar edge, placed vertically beneath: the concussion breaks the smalto to very nearly the shape required; and it is then more perfectly ground by application to a lead wheel covered with emery powder. The piece thus shaped is then moistened with a little cement, and bedded in its proper situation, and so on until the picture is finished; when the whole being ground down to an even face, and polished, becomes an indestructible work of art, rescuing from oblivion beautiful forms too subject to mutability and destruction. Thus have been elaborated some of the noble specimens of Mosaic that decorate St. Peter's, and many of the other Roman churches; and thus in modern times have works been produced, fully rivalling in every respect the most exquisite creations of antique art. Six regularly instructed artists are now constantly employed in the "Fabrica," at the Vatican. The Florentine Mosaic, instead of being composed of a fictile material, is made entirely of marbles, agates, gems, &c., and, by means of these materials only, graceful and elaborate representations of flowers, fruit, ornaments, &c., have been produced. Marbles and jaspers of brilliant colours, being of course very valuable, are only used in thin slices like veneer, and are backed upon slate. The process is extremely tedious; a paper mould having to be cut for every small piece of marble, and each part must be ground at the wheel until it exactly coincides with that pattern. Considering the extreme difficulty of working in such materials, the finished pictures are quite astonishing, and some of the works at present in hand in the Grand Ducal Manufactory at Florence, intended for the high altar in the chapel of the Medici at San Lorenzo, will be the most beautiful specimens yet produced. Of course the demand for such elaborate, and consequently expensive labours, must be very limited, so that the trade cannot be general, and is on that account principally restricted to the formation of chimney ornaments, paper weights, &c.

As far as my observation has extended I am not aware of any effort yet made, by any of the nations of Europe (*except Italy*) for the re-establishment of a Mosaic manufactory. To quote the words of Mr. Ward's very intelligent paper, in Mr. Blashfield's valuable work, on Mosaic floors, "About forty years ago a patent was obtained, by Mr. Charles Wyatt, for a mode of imitating tesselated pavements; by inlaying stone with coloured cements — floors thus constructed, however, were found liable to become uneven in use, in consequence of the unequal hardness of the materials, which defect prevented their general adoption. Terra cotta (or burnt clay) inlaid with coloured cements, has also been tried, but found liable to the same objection."

During the last ten years cements, coloured with metallic oxides, have been used by Mr. Blashfield, and with a tolerably successful result for work protected from the weather; but for out-door work, required to stand frost, it has been found necessary to employ Roman cement, of which the dark brown gives a dingy hue to all colours mixed with it. This, with some other practical difficulties, has interfered with the success of the plan. Bitumen, coloured with metallic oxides, has also been tried by Mr. Blashfield as a material for ornamental flooring. The ground work of the pattern was first cast, in any given colour, and the interstices were afterwards filled up with bitumen of various other shades; but this method was even less successful than the former. The contraction and expansion of the bitumen soon rendered the surface uneven; the dust, trodden in, obscured the pattern, and the plan, besides being ineffectual, was expensive." Thus far I have employed the words of Mr. Ward's record of the difficulties which inevitably attend upon the outset of any ingenious revival; reserving to myself the pleasure of describing to you the progress of more successful experiments.

In the year 1839, Mr. Blashfield, having been called upon by Mr. Hope to construct an elaborate Mosaic flooring for him, at his seat at Deepdene, in Surrey, and bearing in mind the principle of the ancient "Opus incertum," the Venetian pisé, and the common Italian "Trazzo" floors, constructed a pavement which has elicited much admiration from those men of taste who have

examined it. This and many similar efforts attracted more general attention to the subject, and consequently a more general demand, which paved the way for those great improvements in the art of manufacturing and laying down ornamental pavements, which it is now my pleasing duty to describe.

These ingenious inventions, or revivals, are three in number: the first to which I would briefly call your attention is, though not precisely Mosaic in its nature, still so nearly allied to it in character and appliance that it cannot be well separated from it; I allude to the Encaustic tiles. As many here present are doubtless aware, these consisted of a fictile material made into forms of about six inches square, into the surface of which, while still in a soft state, were pressed metal dies, upon which a pattern was worked in relief; the ornament being thus indented, the intaglio or indentation was filled up with clay of a different colour. The tile was then baked, and covered with a vitreous glaze, at once enhancing and protecting the colour of the material. This art obtained universally in England from about 1300 to 1500, and was again revived in 1830, when a patent was taken out for the manufacture of similar tiles; since which period the revival has been carried out on a large scale by Messrs. Minton and Co., of Stoke-upon-Trent, and many other manufacturers, through whose exertions this beautiful decoration has now a very extensive employment.

The second great step in the revival of the art of Mosaic to which I would allude is that made by Mr. Singer (most ably assisted by Mr. Pether) who, in the year 1829, obtained a patent for a most ingenious machine, securing a perfectly uniform Tessera, by very simple means; also greatly improving the mode of backing and laying the pavement. As Mr. Singer's process is very simple and ingenious, I will trespass on your patience by giving a brief description of it. His object was to secure a perfect imitation of the ancient Roman "Opus Tesselatum," and to this end he required to produce tesseræ, or small cubes, uniform in size, hardness, colour, and surface; and to accomplish this he placed compact and well manipulated clay in a machine, where, by means of powerful levers, it was subjected to great pressure, and made to exude at last out of a horizontal aperture of six″ by half an inch. As it protruded it was cut into lengths of three″; and these small pieces of clay, of six″ in length by three″ in breadth, and one-half in depth, were left for some days to dry. Fifteen or twenty of them were then laid upon one another, and a frame of corresponding size (across which were strained wires, crossing one another at regular intervals,) sliding vertically on two uprights, was made to pass through them, cutting out by this motion perhaps one hundred uniform tesseræ. When any curved forms were required the tesseræ were placed angle-wise in a groove, and a piece of curved metal being made to pass through a quantity of them placed together, of course gave a perfect coincidence of form in the parts divided. The tesseræ were then burnt and partially vitrified, making a very nice material, and one by means of which beautiful tesselated pavement may be produced. The works already executed by Mr. Singer, among which may be noticed the flooring of the hall of the Reform Club, and the paving of a portion of Wilton Church, near Salisbury, are of great beauty. And his process needs only the fostering hand of good taste to produce the most beautiful and luxuriant fruits.

The third great improvement to which I would allude, and which carries one branch of the art of Mosaic to even a higher point of perfection than that attained by the ancients, was originally discovered by Mr. Prosser, of Birmingham, in the year 1840. "He found (to quote the words of Mr. Ward) that if the material of porcelain (a mixture of flint and fine clay) be reduced to a dry powder, and in that state subjected to strong pressure between steel dies, the powder is compressed into about a fourth of its bulk, and is converted into a compact substance of extraordinary hardness and density, much less porous and much harder than the common porcelain uncompressed, and baked in the furnace. This ingenious discovery was at first applied by Mr. Prosser to the manufacture of buttons; but the happy idea having suggested itself to Mr. Blashfield, that this process was, of all others, the one best suited for the formation of tesseræ, he made arrangements with Messrs. Minton and Company, who had been employed by Mr. Prosser to carry out this invention, for a supply of small cubes thus formed; and by the application of these he has much benefited the art, and carried out many large works with very great success. These tesseræ can be made of any form, either in squares for tesselation; triangles, and hexagons, for imitation of the "Opus Alexandrinum;" polygons and rhomboids; or of any colour; and by means of enamelling the surface with the most brilliant tints and gold, very perfect substitutes for the ancient glass Mosaic may be produced.

In order to form a Mosaic with these tesseræ, the pattern is first arranged upon a true bench, that is, a perfectly level and rectangular table, and then the tesseræ are placed close together upon it, so as to form

exactly the required ornament; they are then covered over with a cement, discovered by Mr. Blashfield, which sets to an extreme degree of hardness, and perfectly resists both heat and water. Previously to this discovery Roman cement had been employed. On that are bedded strong tiles, or slate backing. When the cement has set, which takes place very quickly, the pavement may be removed and laid down in the situation intended, and will be found to be perfectly true on the face, of an even hardness, imperishable, and unchanging, with an almost imperceptible joint; and, altogether, as beautiful as such a work of art can be. I need not do more than call the attention of the members of this society to the paving of their entrance hall, for the formation of which they are indebted to Mr. Minton and Mr. Blashfield, to convince them of the beauty and perfection to which this art may be carried.

A PARTING WORD TO AN "EX-REVIEWER."

Sir,—The effects of my former letters upon your "Ex-Reviewer" have extended farther than I had wished or anticipated. Carrying out his own analogy, I might say, that while my expostulations were for "reform" only, they have caused an "abdication." Let me then assure your correspondent that I hope he will not confine his communications to the subjects which in a late number of the *Magazine* he proposes to consider, but will resume the dignities and functions he has somewhat hastily relinquished.

I shall not further notice the strong expressions which occur in his last letter, as I am satisfied that I shall thereby leave the field with an advantage on my side; but as I have never been conscious of the intention to give offence, so am I perfectly ready to retract any expressions on my part which could be possibly construed as proceeding from such intention. I trust then, that we—albeit with our vizors down—part shaking hands, and remain, your obedient servant, ±.

Temple, March 25.

NOTES AND NOTICES.

Gold from Violets.—Mr. R. Hunt stated in a recent lecture at the London Institution that he had been informed by a gentleman of the highest chemical standing, that he had extracted from a quantity of the petals of the blue violet a weighable, though a minute, portion of gold. He was not at liberty to name the gentleman, but, were he to do so, every person present would at once recognise him as the highest possible authority on such a question. There might be a mistake in the matter, but he could not believe that that could be the case in such able hands.

Materiality of the Electric Fluid.—Mr. Lake, of the Royal Laboratory, Portsmouth, has communicated to the *Lancet* the results of a singular experiment, which appears to show that the electric agent is really fluid; and that when collected so as not to exert its powers of attraction and repulsion, it obeys the laws of gravitation like carbonic acid and other gases. The electric fluid was received in a Leyden jar insulated on a glass plate. At the lower part of the jar was a crack in the side, of a star-like form, and from around this the metallic coating was removed. On charging the jar, it was observed that the electric fluid soon began to flow out in a stream from the lower opening; and on continuing the working of the machine, it flowed over the lip of the jar, descending in a faint luminous conical stream (visible only in the dark) until it reached the level of the outside coating, over which it became gradually diffused, forming, as it were, a frill, or collar. When the jar was a little inclined on one side, there was a perceptible difference in the time of its escape over the higher and lower parts of the lip, from the latter of which it began to flow first. On discontinuing the working of the machine, the fluid first ceased to flow at the lip of the jar, and then at the lower aperture. On renewing the operation, it first re-appeared at the lower aperture, and afterwards at the mouth. This very ingenious experiment appears to establish the fact, that the electric fluid is material, and is influenced, under certain circumstances, by the laws of gravitation.

Fall and Velocity of Rivers.—The fall of a river influences in part the velocity or force of its current, but not to such an extent that the rate of fall could be taken as a scale for the rate of velocity. The Rhine, Danube, and Elbe are very rapid rivers, yet they only exhibit a fall of one or two, and very seldom three feet per mile. The "gentle Tweed," with an average fall of nearly eight feet, from the affluence of Biggar water to the sea, is freely navigated by small boats—while a fall of only two feet in the Danube causes the greatest obstacles to navigation. The Severn and the Shannon are much alike in magnitude; the average descent of the former is 26·6 inches per mile, of the latter only nine inches; and yet the Severn pursues its course without any rapids or falls, whilst the Shannon forms the magnificent falls of Doonas, equalling the most celebrated in Europe.—*Mr. A. Peterman: Trans. Geog. Soc.*

New Æronautic Machine.—The *Mining Journal* quotes a letter from Rotterdam, dated 7th ultimo, which states that "M. F. L. de Ruijter has invented an æronautic machine, which, instead of requiring the power of the balloon, rises into the air from the *impetus of its own working*, with a weight of 200,000 Netherland lbs., with *immense rapidity*, and can be steered at will." The "impetus of its own working!" What does that mean?

Gutta Percha.—The importations of this article continue to take place in large quantities. A vessel, lately arrived from Sincapore, has brought, as part of an extensive cargo of eastern productions, 1,386 packages, and 5,084 blocks of the article.

Antiquity of Gunpowder.—The first application of gunpowder to the firing of artillery has been commonly ascribed to the English at the battle of Cressy, August, 1346; but hitherto this fact has depended almost solely on the evidence of a single Italian writer, coupled with the circumstance that the word "gunners" has been met with in some public accounts of the reign of Edward III. Upon this point the Rev. J. Hunter has lately communicated to the Society of Antiquaries some new and curious particulars, derived from records of the period, showing the very names of the persons employed in the manufacture of gunpowder (out of saltpetre and "quick sulphur," as it was called, without any mention of charcoal,) and the quantities supplied to the King just previously to his expedition to France in June or July, 1346. In the Records it is termed *pulvis pro ingeniis;* and they establish that a considerable weight had been supplied to the English army subsequently to its landing at La Hogue and previously to the battle of Cressy; and that before Edward III. engaged in the siege of Calais he issued an order to the proper officers in England requiring them to purchase as much saltpetre and sulphur as they could procure.

WEEKLY LIST OF NEW ENGLISH PATENTS.

(*One only Sealed this Week.*)

Benjamin Grey Babington, of George-street, Hanover-square, Middlesex, M.D., and John Spurgin, of Guildford-street, Middlesex, M.D., for improvements in the manufacture of metallic pens. March 27; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs
Mar. 24	1399	J. W. and G. Stevens	Stowmarket Brewery, Stowmarket	Barley or grain riddling machine.
27	1400	Barnabas Urry	Newport, Isle of Wight	Drill.
"	1401	George Jacobs	Cockspur-street	Handle for umbrellas and parasols.
28	1402	Richard Graves	High Holborn, tailor & trousers maker	Waistcoat.
"	1403	Tyler and Son	Warwick-lane	Water-closet.
29	1404	William Jeakes	Great Russell-street, Bloomsbury	Day's Crown windguard and ventilator.
"	1405	Simcox, Pemberton, & Sons	Birmingham	Rack-pulley.
30	1406	Hilliard and Thomason,	Birmingham	Slide and spring safety-brooch.
"	1407	William Preist	Strand, trunk and portmanteau manufacturer	Railway traveller's vade mecum.

CONTENTS OF THIS NUMBER.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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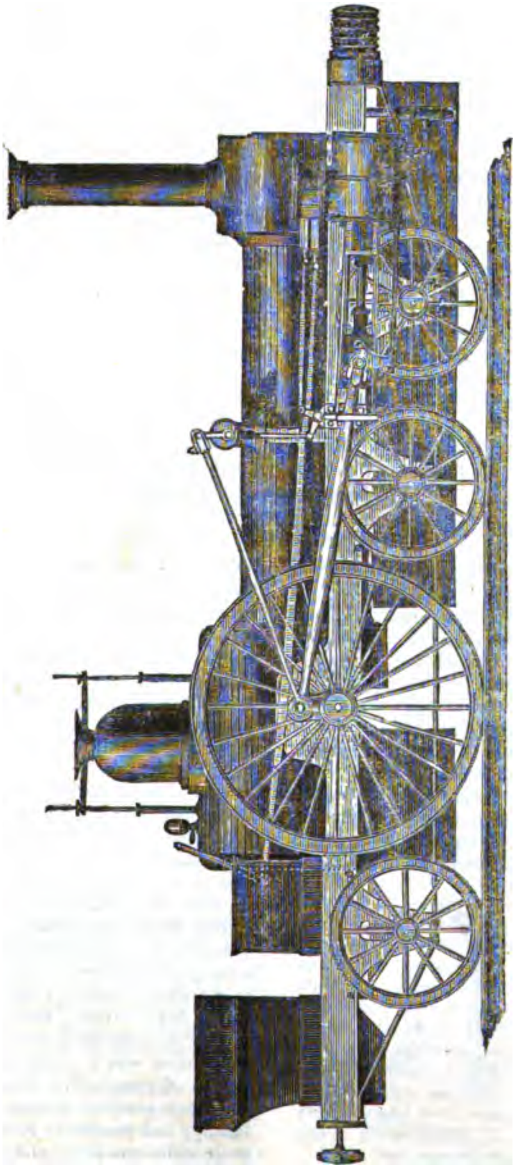
JOHNSON'S PATENT IMPROVEMENTS IN LOCOMOTIVE ENGINES.



MR. W. B. JOHNSON'S PATENT IMPROVEMENTS IN LOCOMOTIVE ENGINES.

SECOND NOTICE.

In our last Number we gave the details of several arrangements by which Mr. Johnson proposes to lower the boilers, and thereby to impart greater steadiness to locomotive engines. The prefixed engraving exhibits the general effect which the adoption of any one of these arrangements would have on the appearance of an engine. With the centre of gravity brought so low down as here represented, and the sizes of all the bearing-wheels diminished (while, at the same time, there would be no diminution whatever in the amount of steam generating surface), there can be no question that an engine would not only travel much more steadily and smoothly, but be much more exempt from liability to accidents.

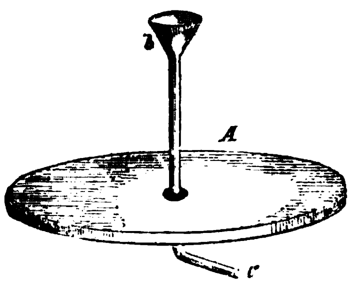
Mr. Johnson proceeds next to describe an improved arrangement for working the eccentrics for giving motion to the slide-valves or feed-pumps—a contrivance for diminishing the friction in eccentrics—two methods of working steam expansively, whereby the throttle valve is got rid of, and one eccentric suffices for each engine—an expanding slide or guide-block—an arrangement for coupling the four wheels of locomotives, and placing the cylinders outside and between the fore and hind wheels—and, lastly, an improved steam-engine whistle.

We must defer, for want of the requisite wood-cuts, a detailed description of these additional improvements, with the exception of the last only, which may be described in a few words. Mr. Johnson has a chamber, which he first exhausts of air ("by a pump worked in any convenient method from a wheel, axle, or otherwise"), and then passes atmospheric air through it. "The advantages," he says, "of this mode of working a signal or whistle are, that the pump or other stationary machinery for exhausting the chamber, can work for any length of time without danger of bursting, as is the case in using steam or compressed air; and simplicity of construction, no safety-valve being required, nor gearing for throwing the pump or exhausting machinery out of work."

(*To be concluded in our next.*)

PROPULSION BY THE WATER-JET.

Sir,—It is surprising, on what shallow grounds, mechanics and many other ingenious persons, will often build all their hopes of bettering their circumstances. One has an infallible scheme for superseding steam; another knows how to make a steam-vessel plough the ocean with the rapidity of the whale; and a third, had he only the golden means, could traverse the boundless fields of air with the ease and certainty of the eagle's flight. But, indeed, these are reasonable conjectures, compared with others that might be adduced, were there any doubt on the matter.



The annexed figure, A, represents a circular board of 12 or 15 ins. diameter, provided with a half-inch metal pipe fixed in the centre, having a funnel-shaped opening at *b*, and bent to nearly right angles at *c*. If this board be allowed to float on water, the pipe, *b*, being uppermost, and water poured from a jug into the funnel, *b*, it will be propelled with great velocity in a direction contrary to the exit at the water-jet at *c*. This was an experiment actually made by a very worthy man, some years ago, a mechanic in respectable circumstances, and he had not the slightest doubt when he saw this clumsy-figured body of a sailing model *scud* along with surprising velocity, that his fortune was made. It soon got rumoured amongst his friends that a great discovery had been made by him, and advice and congratulation flowed in from all quarters. Of course the matter was a profound secret for a length of time. The invention emanating from a sober, practical man, with a family, and not likely to be led away by such chimeras as might, perchance, get

into the head of a younger adept, it was seriously entertained by many parties, with a view to benefit genius struggling with humble circumstances. It would be folly to attempt to paint the delightful anticipations of the inventor's wife, as also of his sons and daughters; it must suffice for my purpose to state that the inventor had, through some private source, satisfied *himself* that the thing was perfectly original, and that nothing of the kind had ever been patented, or described in any scientific journal. As it would be about as unjust to ask a man for particulars of an invention, as it would be suspicious to inquire minutely the amount of cash he possesses and where he locks it up, a happy ignorance for a long time prevailed, until at last an eminent professor, being consulted on the subject, pronounced the entire scheme utterly worthless. This was a sad blow; however, it had its desired effect, and he never after looked over the title-deeds to his Utopian estates.

In these model experiments there is generally left out of calculation the great difference which exists between the vessel of 5 lbs., when represented by 500 tons, and between a half-inch tube and the Goliah of a funnel that would be required for a regular merchantman, together with the powerful pumps that would be necessary to keep up the requisite propelling cascade.

Propulsion by the water-jet has been patented, and practically tried to a very recent period; in short, it has been a favourite scheme, in private, with numerous inventors, each ignorant of the other's plans, and, therefore, each conceiving the originality of his own design to be unquestionable; one of the most untenable proofs, perhaps, that can possibly be offered. I am, Sir, yours, &c.,

H. D.

London, April 8, 1848.

ON THE CHARACTERISTICS AND PROPERTIES OF GUTTA PERCHA. BY THOMAS OXLEY, ESQ., A.B., SENIOR SURGEON OF THE SETTLEMENT OF PRINCE OF WALES ISLAND, SINGAPORE, AND MALACCA.

[From the *Journal of the Indian Archipelago and Eastern Asia*, as quoted in the *Edinburgh New Philosophical Journal*.]

Although the trees yielding this substance abound in our indigenous forests, it is only four years since it was discovered by Europeans. The first notice taken of it appears to have been by Dr. W. Montgomerie, in a letter to the Bengal Medical Board, in the beginning of 1843, wherein he commends the substance as likely to prove useful for some surgical purposes, and supposes it to belong to the fig tribe. In April, 1843, the substance was taken to Europe by Dr. D'Almeida, who presented it to the Royal Society of Arts of London, but it did not at first attract much attention, as the Society simply acknowledged the receipt of the gift; whereas shortly after they thought proper to award a gold medal to Dr. W. Montgomerie for a similar service. Now, as the discovery of both of these gentlemen rested pretty much upon the same foundation, the accidental falling in with it in the hands of some Malays, who had found out its greatest peculiarity, and availed themselves thereof, manufactured it into whips, which were brought into town for sale—there does not appear any plausible reason for the passing over the first, and rewarding the second. Both gentlemen are highly to be commended for endeavouring to introduce to public notice a substance which has proved so useful and interesting. The gutta percha having of late attracted much attention, and as yet but little being known or published about it, I would now propose to supply, to the best of my ability, this desideratum, and give a description of the tree, its product and uses, so far as it has been made available for domestic and other purposes in the place of its origin.

The gutta percha tree, or gutta tuban, as it ought more properly to be called,—the percha producing a spurious article—belongs to the natural family Sapoteæ, but differs so much from all described genera, having alliance with both Achras and Bassia, but differing in some essentials from both, that I am disposed to think it is entitled to rank as a new genus. I shall, therefore, endeavour to give its general character, leaving the honour of naming it to some more competent botanist, especially as I have not quite satisfied myself regarding the stamens, from want of specimens for observations.

The tree is of a large size, from 60 to 70 feet in height, and from 2 to 3 feet in diameter. Its general appearance resembles the genus Durio, or well-known Doorian, so much so as to strike the most superficial observer. The under-surface of the leaf, however, is of a more reddish and decided brown than in the Durio, and the shape is somewhat different.

The flowers are axillary, from one to three in the axils, supported on short curved pedicles, and numerous along the extremities of the branches.

Calyx inferior, persistent, coriaceous, of

a brown colour, divided into six sepals, which are arranged in double series.

Corolla monopetalous, hypogenous, divided, like the calyx, into six accuminate segments.

Stamens inserted into throat of the corolla, in a single series, variable in number, but, to the best of my observation, the normal number is twelve, most generally all fertile; anthers supported on slender bent filaments, opening by two lateral pores.

Ovary superior, terminated by a long simple style, six-celled, each cell containing one seed.

Leaves about four inches in length, perfect, entire, of a coriaceous consistence, alternate, obovate, lanceolate; upper surface of a pale green; under surface covered with close, short, reddish-brown hairs; midrib projects a little, forming a small process or beak.

Every exertion of myself and several others have failed in procuring a specimen of the fruit of the gutta. I regret being compelled to omit the description of it in the present instance; but hope to rectify this omission in a future number of the Journal. It is quite extraordinary how difficult it is to obtain specimens of either the flower or the fruit of this tree, and this is probably the reason of its not having been earlier recognised and described by some of the many botanists who have visited these parts.

Only a short time ago the tuban tree was tolerably abundant on the island of Singapore; but already all the large timber has been felled, and few, if any, other than small plants are now to be found. The range of its growth, however, appears to be considerable, it being found all up the Malayan peninsula, as far as Penang, where I have ascertained it to be abundant; although, as yet, the inhabitants do not seem to be aware of the fact, several of the mercantile houses there having sent down orders to Singapore for supplies of the article, when they have the means of supply close at hand. The tree is also found in Borneo, and, I have little doubt, is to be found in most of the islands adjacent.

The localities it particularly likes are the alluvial tracts along the foot of hills, where it flourishes luxuriantly, forming, in many spots, the principal portion of the jungle. But, notwithstanding the indigenous character of the tree, its apparent abundance and wide-spread diffusion, the gutta will soon become a very scarce article, if some more provident means be not adopted in its collection than those at present in use by the Malays and Chinese.

The mode in which the natives obtain the gutta is by cutting down the trees of full growth, and ringing the bark at distances of about twelve to eighteen inches apart, and placing a cocoa-nut shell, spathe of a palm, or such like receptacle, under the fallen trunk, to receive the milky sap that immediately exudes upon every fresh incision. This sap is collected in bamboos, taken to their houses, and boiled, in order to drive off the watery particles and inspissate it to the consistence it finally assumes. Although the process of boiling appears necessary when the gutta is collected in large quantity, if a tree be freshly wounded, a small quantity allowed to exude, and it be collected and moulded in the hand, it will consolidate perfectly in a few minutes, and have all the appearance of the prepared article.

When it is quite pure, the colour is of a greyish white; but, as brought to market, it is more ordinarily found of a reddish hue, arising from chips of bark that fall into the sap in the act of making the incisions, and which yield their colour to it. Besides these accidental chips, there is a great deal of intentional adulteration by sawdust and other materials. Some specimens I have lately seen brought to market could not have contained much less than one quarter of a pound of impurities; and even the purest specimens I could obtain for surgical purposes, one pound of the substance yielded, on being cleansed, one ounce of impurities. Fortunately, it is neither difficult to detect or clean the gutta of foreign matter, it being only necessary to boil it in water until well softened, roll out the substance into thin sheets, and then pick out all impurities, which is easily done, as the gutta does not adhere to anything, and all foreign matter is merely entangled in its fibres, not incorporated in its substance. The quantity of gutta obtained from each tree varies from five to twenty catties, so that, taking the average at ten catties, which is a tolerably liberal one, it will require the destruction of ten trees to produce one picul. Now, the quantity exported from Singapore to Great Britain and the continent, from 1st January, 1845, to the present date, amounts to 6,918 piculs, to obtain which 69,180 trees must have been sacrificed. How much better would it, therefore, be to adopt the method of tapping the tree practised by the Burmese in obtaining the caoutchouc from the *Ficus elastica* (viz., to make oblique incisions in the bark, placing bamboos to receive the sap, which runs out freely), than to kill the goose in the manner they are at present doing! True, they would not at first get so much from a single tree, but the ultimate gain would be incalculable, particularly as the tree seems to be one of slow growth, by no means so

rapid as the *Ficus elastica*. I should not be surprised, if the demand increases, and the present method of extermination be persisted in, to find a sudden cessation of the supply.

Properties of the Gutta.

This substance when fresh and pure is, as already mentioned, of a dirty white colour, and of a greasy feel, with a peculiar leathery smell. It is not affected by boiling alcohol, but dissolves readily in boiling spirits of turpentine, also in naphtha and coal-tar. A good cement for luting bottles and other purposes, is formed by boiling together equal parts of gutta, and coal-tar, and resin. I am indebted for this hint to Mr. Little, surgeon, and the above were his proportions. I have, however, found it necessary to put two parts of the gutta, that is one-half instead of one-third, to enable the cement to stand the heat of this climate. When required for use, it can always be made plastic by putting the pot containing it over the fire for a few minutes. The gutta itself is highly inflammable, a strip cut off takes light, and burns with a bright flame, emitting sparks, and dropping a black residuum in the manner of sealing-wax, which in its combustion it very much resembles. But the great peculiarity of this substance, and that which makes it so eminently useful for many purposes, is the effect of boiling water upon it. When immersed for a few minutes in water above 150° Fahrenheit, it becomes soft and plastic, so as to be capable of being moulded to any required shape or form, which it retains upon cooling. If a strip of it be cut off, and plunged into boiling water, it contracts in size both in length and breadth. This is a very anomalous and remarkable phenomenon, apparently opposed to all the laws of heat.

It is this plasticity when plunged into boiling water that has allowed of its being applied to so many useful purposes, and which first induced some Malays to fabricate it into whips, which were brought into town, and led to its further notice. The natives have subsequently extended their manufactures to buckets, basins, and jugs; shoes, traces, vessels for cooling wines and several other domestic uses; but the number of patents lately taken out for the manufacture of the article in England, proves how much attention it has already attracted, and how extensively useful it is likely to become. Of all the purposes, however, to which it may be adapted, none is so valuable as its applicability to the practice of surgery. Here it becomes one of the most useful auxiliaries to that branch of the healing art, which of all is the least conjectural. Its easy plasticity and power of retaining any shape given to it when cool, at once pointed it out as suitable for the manufacture of bougies, and accordingly my predecessor, Dr. W. Montgomerie, availed himself of this, made several of the above instruments, and recommended the use of it to the Bengal Medical Board. But like many other good hints, for want of sufficient inquiry, I fear it was disregarded. The practice, however, has been continued by me, and I find many advantages in the use of this substance. It also answers very well for the tubes of syringes, which are always getting out of order in this country, when made of caoutchouc. But my late experiments have given it a much higher value, and proved it the best and easiest application ever yet discovered in the management of fractures, combining ease and comfort to the patient, and very much lessening the trouble of the surgeon. When I think of the farrago of bandages and splints got rid of, the lightness and simplicity of the application, the gutta would be no trifling boon to mankind were it to be used solely for this and no other purpose. The injuries coming under my observation, wherein I have tested its utility, have, as yet, only been two compound fractures of the leg, and one of the jaw; but so admirably has it not only answered, but exceeded my expectations, that I should think myself culpable in not giving the facts early publicity. Its utility in fracture of the lower jaw must at once strike any surgeon. So well does it mould itself to every sinuosity that it is more like giving the patient a new bone than a mere support. A man lately brought into hospital, who had his lower jaw broken by the kick of a horse, and which was so severe as to cause hæmorrhage from the ears, smashing the bone into several fragments, was able to eat and speak three days after the accident, and felt so well with his gutta splint, that he insisted on leaving the hospital within ten days. My mode of applying this substance to fractures of the leg is as follows:

The gutta having been previously rolled out into sheets of convenient size, and about one-fourth of an inch in thickness, is thus kept ready for use. When required, a piece of the necessary length and breadth is plunged into a tub of boiling water. The limb of the patient is then gently raised by assistants, making extension in the usual manner. The surgeon, having ascertained that the broken bone is in its place, takes the sheet of gutta out of the hot water, and allows it to cool for a couple of minutes. It is still soft and pliable as wash leather. Place it whilst in this state under the limb, and gently lower the latter down on it. The gutta is then to be brought round and

moulded carefully to the whole of the back and sides of the leg, bringing the edges close together, but not uniting them. If there be any superfluous substance, it can be cut off with a scissor, leaving an open slit down the front of the leg. You have now the leg in a comfortable, soft, and smooth case, which, in ten minutes, will be stiff enough to retain any shape the surgeon may have given it, and which will also retain the bone *in situ*. Place the leg so done up on a double inclined plane, and secure it thereto by passing three of the common loop bandages around the whole; that is, one at the top, one in the middle, and one at the lower end. Let the foot be supported by a foot-board, and a case of gutta put over the dorsum of the foot, to bear off the pressure of the small bandage generally used to secure it to the board. Having done this, the surgeon need not cause his patient another twinge of pain until he thinks he can use the leg, or he deems the bone sufficiently united to bear the weight of his patient. If it be a compound fracture, it will be only necessary to untie the loop bandages, separate the edges of the gutta splint to the required distance, wash and cleanse the limb without shifting anything except the dressings, and, having done so, shut it up again. The most perfect cleanliness can be maintained, as the gutta is not affected by any amount of ablution; neither is it soiled or rendered offensive by any discharge, all which washes off as easily from the gutta case as from oil-cloth. I have had a patient where the tibia protruded through the integuments fully two inches, walking about in six weeks from the injury, with a leg as straight and well-formed as ever it had been. It is quite obvious, therefore, that if it answers so well for compound, it will answer equally, if not better, for simple fractures; and that any broken bone capable of receiving mechanical support can be supported by the gutta better than by any other contrivance; for it combines lightness and smoothness, durability, and a capability of adjustment, not possessed by any other known substance. All new experiments have to run the gauntlet of opposition, and I do not suppose that these recommendations will prove an exception to the rule; but all I ask of any surgeon is to try the experiment ere he argues on its propriety, and I feel fully convinced that all other splints and bandages will be consigned to the tomb of the Capulets. There are some other uses for which I have tried this substance, viz., as capsules for transmission of the vaccine virus, which ought to keep well when thus protected, for it is most perfectly and hermetically sealed; but I have not had sufficient experience in this mode of using it to pronounce decidedly on its merits. I am at present trying the effects of it on ulcers, by inclosing the ulcerated limb in a case of gutta so as to exclude all atmospheric air, and, so far, the experiment promises success.

Since writing the foregoing observations, I have had an official intimation from Penang of the vaccine virus transmitted in the gutta capsules having been received in good order, and of its having succeeded most satisfactorily. I have also opened a capsule containing a vaccine crust that had been kept here for one month, and it also seems to have lost none of its efficacy, as the case inoculated has taken. This will appear the more striking when it is recollected that, to preserve the vaccine virus hitherto in Singapore, even for a few days, has been almost impossible; that this settlement, notwithstanding every exertion on the part of both private and public practitioners, has been without the benefit of this important prophylactic for an interval sometimes of two years; and that, at all times, the obtaining and transmitting this desirable remedy has been a cause of trouble and difficulty to all the medical officers I have ever met with in the Straits.

I observed in the *Mechanics' Magazine*, for March, 1847, a notice of several patents taken out for the working of this article by Mr. Charles Hancock, in which an elaborate process is described for cleaning the gutta, as also mention of its having a disagreeable acid smell. The gutta, when pure, is certainly slightly acid, that is, it will cause a very slight effervescence when put into a solution of soda, but is unaffected by liquor potassa. The smell, although peculiar, is neither strong nor unpleasant, so that the article experimented upon must have been exceedingly impure, and possibly derived a larger portion of its acidity from the admixture and fermentation of other vegetable substances. Again: it appears to me that, if the gutta be pure, the very elaborate process described as being necessary for cleaning it, is superfluous. The gutta can be obtained here in a perfectly pure state by simply boiling it in hot water until well softened, and then rolling it out into thin sheets, when, as I have before said, all foreign matter can be easily removed. I would recommend that the manufacturers at home should offer a higher price for the article if previously strained through cloth at the time of being collected, when they will receive the gutta in a state that will save them a vast deal more in trouble and expense than the trifling addition necessary to the original prime cost.

EASY INVESTIGATION OF A GENERAL THEOREM IN ANALYTICAL TRIGONOMETRY. BY PROFESSOR YOUNG, BELFAST.

The following easy investigation of a general theorem in analytical trigonometry is, I believe, new: it may, possibly, interest some of the readers of the *Mechanics' Magazine*. It is based upon a theorem of Euler, which may itself be readily established thus:

In the identity

$$A_1 = (A_1 - A_2) + (A_2 - A_3) + (A_3 - A_4) + \ldots (A_{n-1} - A_n) + A_n,$$

put

$$A_1 = \tan^{-1} t_1,\ A_2 = \tan^{-1} t_2,\ A_3 = \tan^{-1} t_3, \text{ \&c.},$$

and we have

$$\tan^{-1} t_1 = \tan^{-1} \frac{t_1 - t_2}{1 + t_1 t_2} + \tan^{-1} \frac{t_2 - t_3}{1 + t_2 t_3} + \tan^{-1} t_n,$$

which is Euler's theorem.

Now, call these several fractions x_1, x_2, &c., and put x_n for t_n; then we very easily get

$$t_1 = \frac{x_1 + t_2}{1 - x_1 t_2},\quad t_2 = \frac{x_2 + t_3}{1 - x_2 t_3},$$

$$t_3 = \frac{x_3 + t_4}{1 - x_3 t_4},\quad t_4 = \frac{x_4 + t_5}{1 - x_4 t_5},$$

$$\vdots$$

$$t_{n-1} = \frac{x_{n-1} + x_n}{1 - x_{n-1} x_n}.$$

And it is plain, without actually performing the work, that if for t_2 in the first fraction, we substitute its value given by the second, and reduce, by multiplying by the denominator of the latter, the numerator of t_1 will be the sum minus the product of all three of the letters x_1, x_2, t_3. If, again, we substitute in this numerator the value of t_3 in the next fraction, reducing, as before, by multiplying by the denominator of t_3, it is equally plain, the first term of the denominator being 1, and the second x_3, t_4, that we shall get the sum of all the letters now employed minus all the products of three. Introducing, in like manner, the next fraction in place of t_4, and observing that the multiplier used in the reduction of the fraction is still unit minus the product of *two* factors, the reduced numerator will, in addition to the sum of the letters minus the products of three, involve also the product of all five, and with a plus sign. And, proceeding in this way, it is obvious, from the unvarying form of the denominators of t_2, t_3, t_4, &c., that, calling the sum of the letters x_1, x_2, x_3, &c, S_1, the sum of their products, two and two, S_2, three and three, S_3, &c., the final expression for the numerator of t will be $S_1 - S_3 + S_5 - S_7 + \ldots.$

From similar considerations, the final expression for the denominator is readily seen to be $1 - S_2 + S_4 - S_6 + \ldots.$

But, from Euler's theorem,

$$\tan^{-1} t_1 = \tan^{-1} x_1 + \tan^{-1} x_2 + \ldots\ldots \tan^{-1} x_n;$$

therefore, putting A, B, C, &c. for the arcs in the second member of this equation,

$$t_1 = \tan\,(A + B + C + \&c.)$$

Comparing this with the foregoing fractional expression for t_1, we have the theorem proposed for investigation, viz.,

$$\tan\,(A + B + C + \&c.) = \frac{S_1 - S_3 + S_5 - S_7 + \ldots}{1 - S_2 + S_4 - S_6 + \ldots}$$

If, instead of the identity employed above, for the purpose of obtaining Euler's theorem, we use the following, viz.:

$$A_1 = (A_1 + A_2) - (A_2 + A_3) + (A_3 + A_4) - \ldots\ldots \pm A_{n-1} + A_n) \pm A_n,$$

we shall obtain the analogous theorem

$$\tan^{-1}t_1=\tan^{-1}\frac{t_1+t_2}{1-t_1t_2}-\tan^{-1}\frac{t_2+t_3}{1-t_2t_3}+\ldots\ldots\pm\tan^{-1}t_n,$$

the upper sign of the final term being taken when the number of preceding terms is odd, and the lower when the number is even. The former theorem, however, becomes obviously convertible into this, by making every t with an even index negative; and it may not be uninteresting to observe that, in these two developments of $\tan^{-1}t$, any *even* number of the leading terms of the one will, in the aggregate, be identical with the same number of the leading terms of the other.

It is easy to see that each of the two identities for A_1, exhibited above—and which are nothing more than obvious truisms—may be employed for other developments besides those for $\tan^{-1}t_1$:—Trigonometry suggests several: and it is not unlikely, simple as the forms are, that they may be turned to account in more advanced inquiries respecting developments; for it is to such general truisms as these that some of the most comprehensive theorems in pure analysis and in analytical dynamics are immediately referable.

J. R. YOUNG.

Postscript, April 10.—From the last number of the Magazine, just received here, I find that the few remarks on a recent communication, which I had appended to the preceding paper, are printed in a detached form. I wish to be permitted to add, in this Postscript, that no such prominence was intended for so trivial a matter; and that I must not be considered as formally making the slightest claim to any anticipation of the views of "*da.*"—J. R. Y.

FIRST REPORT ON THE COALS SUITED TO THE STEAM NAVY. BY SIR HENRY DE LA BECHE AND DR. LYON PLAYFAIR.

(Concluded from page 353.)

The best Cornish engines are stated to raise 1,000,000 lbs. to the height of one foot, by every pound of coal consumed; so that only about one-eighth of the *actual* force generated becomes available, or only one-eleventh or one-twelfth of the force theoretically possible, is applied in practice. The various experiments made on boilers, with regard to the evaporative power of coal, have not given very uniform results. Smeaton, in 1772, with one pound of Newcastle coals, evaporated 7·88 lbs. of water from 212°; Watt, in 1788, came to the conclusion that 8·62 lbs. of water might be evaporated by the same quantity of coal; and later (in 1840), Wicksteed found that 1 lb. of Merthyr coal could be made to evaporate 9·493 lbs. of water from 80°, which is equal to 10·746 lbs. from 212°. In some experiments made on the boiler of the Loam's engine, at the United Mines, in Cornwall, each pound of coal was found, by a trial of six months, to evaporate 10·29 lbs. of water from 212°, this being the reduction of the result given, viz., that 234,210 cubic feet of water at 102° were evaporated by 700 tons of coal. Statements have indeed been made that 14 lbs. of water have been evaporated by 1 lb. of coal burned in Cornish boilers; but as this is the utmost quantity theoretically possible, it is difficult to conceive that it has been realised in practice, even in the best constructed steam-engines.

To ascertain how far our boiler was inferior to Cornish boilers, as principally from its small size and less efficient coating it was likely to prove, we requested Mr. Phillips to make some experiments on one of the best engines in Cornwall, the results of which are given in the Appendix, Section II. It was found by these experiments that 11·42 lbs. of water were evaporated by every pound of Welsh coal corresponding in composition to that of Mynydd Newydd; or, in other words, that improved Cornish boilers on a large scale may be assumed to have a superiority of nearly 20 per cent. over that used in these experiments. As the results stated in this Report are only relative, the comparison is not affected by this difference.

We have anxiously looked to the application of these experiments to the different varieties of patent fuel, but we have not been able to carry out our observations in this direction to the extent we could have desired, from our inability to procure patent fuels in sufficient number, although our applications to the patentees have been numerous. Three varieties have been already examined, viz., those manufactured under the patents of Messrs. Wylam, Warlich, and Bell, and the results are given in the Tables. The varieties of patent fuel are generally made up in the shape of bricks, and are therefore well adapted for stowage; so that, though the specific gravity of patent

fuels is lower than that of ordinary coals, from their shape and mechanical structure, there are very few coals which could be stowed in a smaller space per ton. While we look to the different varieties of patent fuel as of the highest importance, and, from their facility of stowage, as being peculiarly adapted for naval purposes, and perhaps even destined to supersede ordinary coal, at the same time, the greater part do not appear to be manufactured with a proper regard to the conditions required for war steamers. It is usual to mix bituminous or tarry matter with bituminous coal, and from this compound to make the fuel. An assimilation to the best steam coals would indicate, however, the very reverse process, and point to the mixture of a more anthracitic coal with the bituminous cement. As the greater part is at present made, it is almost impossible to prevent the emission of dense opaque smoke—a circumstance extremely inconvenient to ships of war, as betraying their position at a distance at times when it is desirable to conceal it. Besides this and other inconveniences, the very bituminous varieties are not well suited to hot climates, and are as liable to spontaneous combustion as certain kinds of coal. To avoid these inconveniences, some kinds of patent fuels have been subjected to a sort of coking, and thus, in a great measure, obtain the desired conditions. There is little doubt, however, that notwithstanding the large number of patents in operation for the manufacture of fuel, its value for the purposes of war steamers might be much enhanced by its preparation being specially directed to this object. It will be seen, by reference to Table II., that the three patent fuels examined rank among the highest results obtained. Should it be desirable to continue this inquiry, we conceive that it would be advantageous to pay especial attention to this subject, by experimenting upon proper mixtures of different coals. Even anthracite may be introduced into such mixtures with advantage.

It is of much importance, in an economical inquiry on coals, to obtain exact information as to the effects likely to be produced upon them by stowage, and continued exposure to high temperature, not only as regards their deterioration, but also as to the emission of dangerous gases by their progressive changes.

The retention of coal in iron bunkers, if these are likely to be influenced by moisture, and especially when by any accident wetted with sea-water, will cause a speedy corrosion of the iron, with a rapidity proportionate to its more or less efficient protection from corroding influences. This corrosion seems due to the action of carbon or coal forming with the iron a voltaic couple, and thus promoting oxidation. The action is similar to that of the tubercular concretions which appear on the inside of iron water-pipes, when a piece of carbon, not chemically combined with the metal, and in contact with saline waters, produces a speedy corrosion. Where the "make" of iron shows it to be liable to be thus corroded, a mechanical protection is generally found sufficient. This is sometimes given by Roman cement, by a lining of wood, or by a drying oil driven into the pores of the iron under great pressure.

Recent researches on the gases evolved from coal, prove that carbonic acid and nitrogen are constantly mixed with the inflammable portion, showing that the coal must still be uniting with the oxygen of the atmosphere, and entering into further decay.

Decay is merely a combustion proceeding without flame, and is always attended with the production of heat. The gas evolved during the progress of decay, in free air, consists principally of carbonic acid—a gas very injurious to animal life. It is well known that this change in coal proceeds more rapidly at an elevated temperature, and therefore is liable to take place in hot climates. Dryness is unfavourable to the change, while moisture causes it to proceed with rapidity. When sulphur or iron pyrites (a compound of sulphur and iron) is present in considerable quantity in a coal still changing under the action of the atmosphere, a second powerful heating cause is introduced, and both acting together, may produce what is termed *spontaneous combustion*. The latter cause is in itself sufficient, if there be an unusual proportion of sulphur or iron pyrites present.

The best method of prevention, in all such cases, is to ensure perfect dryness in the coals when they are stowed away, and to select a variety of fuel not liable to the progressive decomposition to which allusion has been made. This is, however, a subject of so much importance to the steam navy, that it continues to receive our careful attention; and, beyond these general recommendations, it would be premature to offer any decided course for adoption, from the present limited series of observations.

Several varieties of coal were transmitted from Formosa and from Borneo, for analysis, the results of which are contained in the accompanying Table. The quantity of each kind was so small that no experiments could be made on their evaporative value. We extract from the preceding Table the following results:

Name.	Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ashes.	Specific Gravity.
Formosa Island	78·26	5·70	0·64	0·49	10·95	3·96	1·24
Borneo, Labuan kind	64·52	4·74	0·80	1·45	20·75	7·74	1·28
„ 3 feet seam	54·31	5·03	0·98	1·14	24·22	14·32	1·37
„ 11 feet seam	70·33	5·41	0·67	1·17	19·19	3·23	1·21

It may be desirable to sum up, in a few words, some of the principal points alluded to in the previous parts of this Report. It has been shown that the true practical value of coals for steam purposes depends upon a combination of qualities which could only be elicited by carefully and properly continued experiments. Their qualities, so far as regards steam-ships of war, may be stated as follows:

1. The fuel should burn so that steam may be raised in a short period, if this be desired; in other words, it should be able to produce a quick action.
2. It should possess high evaporative power, that is, be capable of converting much water into steam, with a small consumption of coal.
3. It should not be bituminous, lest so much smoke be generated as to betray the position of ships of war when it is desirable that this should be concealed.
4. It should possess considerable cohesion of its particles, so that it may not be broken into too small fragments by the constant attrition which it may experience in the vessel.
5. It should combine a considerable density with such mechanical structure that it may easily be stowed away in small space; a condition which, in coals of equal evaporative values, often involves a difference of more than 20 per cent.
6. It should be free from any considerable quantity of sulphur, and should not progressively decay; both of which circumstances render it liable to spontaneous combustion.

It never happens that all these conditions are united in one coal. To take an instance: anthracite has very high evaporative power, but, not being easily ignited, is not suited for quick action; it has great cohesion in its particles, and is not easily broken up by attrition, but it is not a caking coal, and therefore would not cohere in the furnace when the ship rolled in a gale of wind; it emits no smoke, but from the intensity of its combustion causes the iron of the bars and boilers to oxidate or waste away rapidly. Thus, then, with some pre-eminent advantages, it has disadvantages which, under ordinary circumstances, preclude its use. The conditions above alluded to may, however, often be united in fuels artificially prepared from coals possessing these various qualities, somewhat in the manner of what are usually termed "patent fuels," and we have recommended that experiments should be made with this object, especially directed to the wants of the steam navy. Whilst we look with this view to artificial fuel as being of special importance, it was quite necessary to obtain a knowledge of coals in different districts, and, for this purpose, Wales was first selected for examination, as producing coals of all kinds varying from bituminous to anthracitic.

While the experiments devised to obtain information on the various points alluded to have been conducted with all proper precaution, in order that constant *comparative* results might be procured, they have not been overburdened with scientific corrections, which might have been necessary to obtain absolute truth, but would have introduced an affectation of accuracy where practical results only were required; to the latter, therefore, this Report has been principally confined. The Report has been so divided as to bring the results together without complicating them with the details of the properties peculiar to each coal, information on which is of the highest value. Hence, in Table II., the practical results of the experiments are brought together, while the equally practical information regarding each coal, its local position, the port from whence it is shipped, its price, its peculiar characteristics in burning, the greater or less quantity of smoke and of ashes which it produces, the description of the coal, its geological position, and other similar points of importance in practice, are detailed for each coal in Section II. of the Appendix.

The composition and specific gravities of the coals, and the quantity of coke which they produce, are given in Table III., not only as a means for their future identification, but also as a standard of quality, with relation to which particular kinds may be purchased. The amount of sulphur, as given in this Table, is of considerable importance in determining the value of the coal for naval purposes, as a means of avoiding the risk of spontaneous combustion.

The heating values of the coal are given in Table IV., as a simpler and more ready method of identification, enabling the purchaser to insure the sample of the coal of a certain heating value.

Table V. shows how the inquiry might easily be extended to other branches of national industry, especially to gas manufactures, but is only adduced as an example of its applicability for such purposes.

Table VI. is principally for the purpose of showing that the actual duty obtained by the combustion of coal in the best applied practice is only a small part of that which the fuel is capable of producing, and is brought forward as an inducement to improvement in the construction of the furnaces and boilers employed for the production of steam. Attention is also drawn in this Table to the great loss which agriculture suffers by the waste of ammonia always produced in the coking of coal, and which might to a great extent be economised by very simple adjustments to the ovens used in coking. The economy and consequent reduction of price in the ammoniacal salts, by preventing this great loss in a material so well fitted to aid increased production in land, would be a great boon to agriculture. Suggestions have also been thrown out as to the more economical application of fuel for domestic and for manufacturing purposes.

In concluding this First Report, we cannot refrain from drawing attention to the kind manner in which we have been assisted by various public and private institutions and companies, without whose aid the expenses of the inquiry would have been materially increased.

The College for Civil Engineers, at Putney, afforded us, gratuitously, ground upon which to erect the boilers, and a house and yard for the stowage of the coals. The laboratory and workshops of the college were also placed at the disposal of the investigation, and have constantly been used. The Principal of the College, the Rev. Mr. Cowie, on all occasions, afforded his valuable aid in the prosecution of the experiments.

The owners of the collieries, from which the coals were obtained, furnished them free of expense; and the Great Western Railway Company, with an enlightened liberality, carried those sent to Bristol on their railway to London without charge. To Mr. George Rennie, the eminent engineer, the inquiry is especially indebted. This gentleman not only lent a tubular boiler, gratuitously, to enable the experiments to be repeated on this kind of boiler, but he also offered his premises for the prosecution of the experiments, which offer was accepted, until the larger space at the College for Civil Engineers was placed at the disposal of the investigation.

Such ready and liberal co operation of the public shows their appreciation of the important practical results which may be expected from these experiments. Seeing the present effective state of the boilers and other apparatus erected at Putney, consequently, that the expenditure on this account has been incurred, and that any further charges for continuing these investigations would chiefly consist of payments of salaries to the persons employed as assistants, we would suggest for consideration, that these experiments may be extended to the coals of other districts than those the coals from which have been examined, and that the needful expenditure may be sanctioned for one or two years more. Should this be deemed advisable, we should anticipate that a most important body of information would be accumulated, alike important to the naval service and the public at large.

We have the honour to be, &c.,

H. T. De La Beche.
Lyon Playfair.

[We shall give hereafter an abstract of the matters in the Appendix to this Report.—Ed. M. M.]

ELECTRICITY OF EXCITED PAPER.

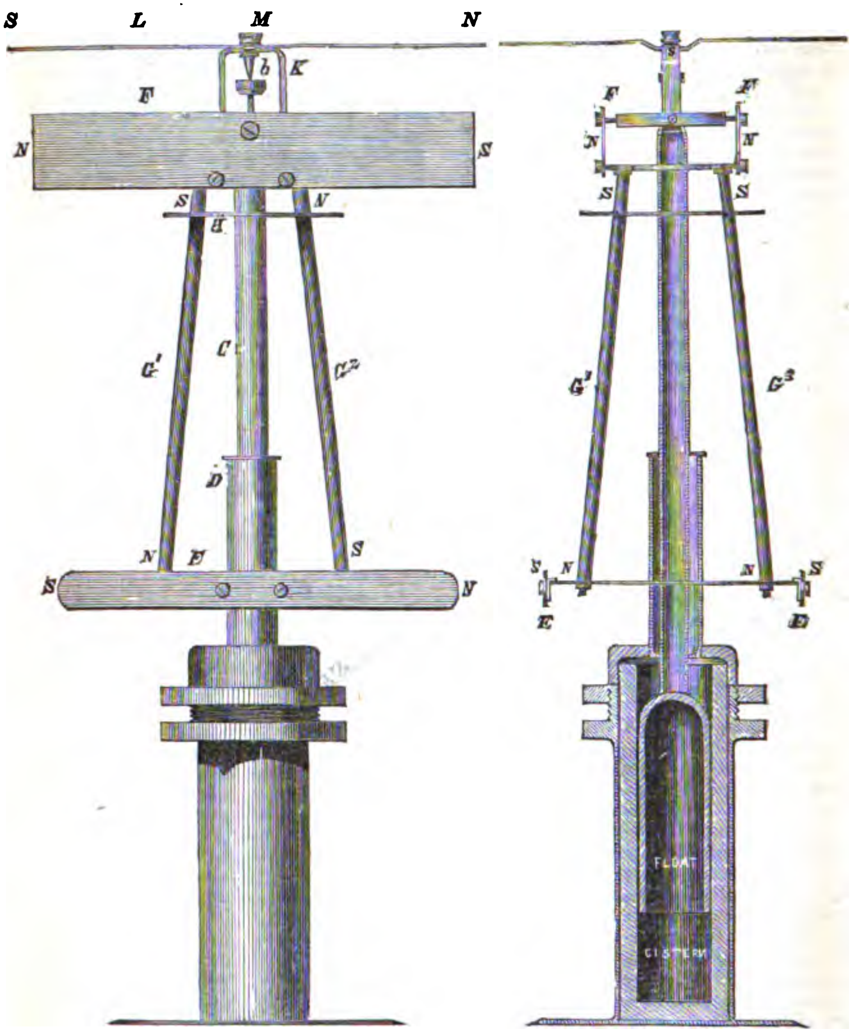
Sir,—I perceive that your Cambridge correspondent, Mr. Barber, has written you upon the electricity of excited paper. The very same fact was communicated to the *Glasgow Mechanics' Magazine* in April, 1824, and I am mistaken if it was not known long prior to that period; however, the fact is not the less astonishing when observed by any one for the first time. About six years ago, when I became first aware of the phenomenon, I constructed a machine having a stout sheet of pasteboard covered with grey paper (instead of the glass plate of Dr. Ingenhousz's machine). The sheet was about 30 inches in diameter. When it was excited by four pairs of cushions, covered with woollen cloth, its power was much superior to a glass plate of the same size. The only objection I had to it was, that it required a considerable time before it could be brought into good working order, owing to the great attraction which the paper had for moisture when standing for any length of time out of use. The electrical properties of silk were discovered in 1729, by Mr. Stephen Gray, and they have formed a matter of amusement and instruction to all subsequent experimenters.

I am, Sir, yours, &c.,

James Millar.

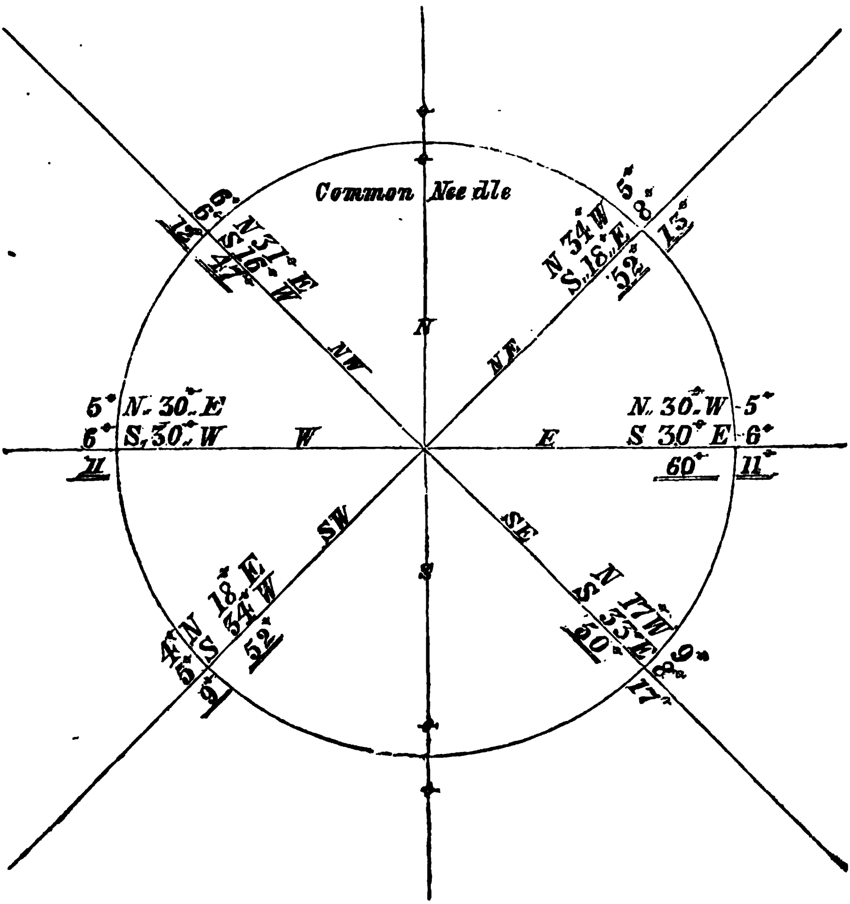
Galashiels, March 18, 1848.

BUSH'S PATENT COMPASS



"A ship and a half a day" is the average loss sustained by Great Britain from shipwreck. No doubt a large portion of this enormous loss is owing to dangers and difficulties, natural to and inseparable from the navigation of the seas; some considerable portion also may very certainly be traced to what our old friend Captain Ballingall calls "the ship-sinking system of Lloyd's;" another by no means indifferent portion is attributable to the gross ignorance and incapacity of a large number of the persons entrusted with the command of ships; but, much of it, is also to be ascribed to a prevailing defectiveness—long since suspected, but only of late years clearly ascertained—in that famous instrument, on the infallibility of which, as a guide over the pathless deep, the mariner has been, from time immemorial, accustomed to place implicit reliance. "As true as the needle to the pole," is an adage which

recent observations have shown to have but very slender founda ion in truth. Nothing, in fact, is more untrue—nothing more inconstant and variable; as fickle as any gallant when *attractive metal* comes in the way. The disturbing influence which masses of iron on board ships exert on the needle, and the consequent uncertainty of its indications, were noticed as far back as the time of Dampier; but the subject cannot be said to have occupied any serious share of public attention till the appearance of the well-known works of Mr. Bain (1817)



and Professor Barlow (1820), which led, some years later, to the appointment by the Lords of the Admiralty, of a Compass Committee, which has devoted itself with great zeal and ability to the rectification of the compasses of the Royal Navy: (the *mercantile* navy has still to be cared for.) Of the necessity for such an appointment, no better proof need be adduced than is contained in the following interesting extract from a paper in the *Nautical Magazine* by our esteemed correspondent Mr. Walker, Queen's Harbour Master at Plymouth:

"On Dec. 30, 1818, being in command of a king's store ship laden with *iron tanks*, and bound to Plymouth, and knowing that these tanks would exert an influence upon the compasses, a course was steered W.N.W. from St. Catharine's Point for the Start. There was a fresh breeze at east, and clear weather; but at daylight the Start bore

NN.E. twenty-one miles! In this case the ship was at least eight leagues farther to the southward than she ought to have been by steering W.N.W. I was not then aware of the fact that an iron *tank* would exert a magnetic influence equal to a *solid cube* of the same dimensions.

"On the 26th of March, 1803, H.M.S. *Apollo* sailed from the Cove of Cork as the convoy of seventy sail of merchant ships. On the 2nd of April, at three in the morning, *the frigate and forty sail of her convoy* went on shore on the coast of Portugal, at a time they imagined themselves to be *three degrees to the westward!* The loss of these ships may be ascribed to the local attraction of the frigate upon her compasses, for about thirty sail of the convoy had during the night wore to the north-west and escaped destruction: this convoy had been steering for several days in a south-west direction. The north point of the frigate's compass would be drawn forward, thereby indicating a course farther to the westward than the ships were really steering, and hence the melancholy loss of so many ships.

"Being in the command of H.M.S. *Royal William* recently launched and equipped at Pembroke, I was directed not to put to sea without two steam frigates, ordered to accompany me to Plymouth; they arrived, and towed the ship down Milford Haven and out to sea. Sail was then made with a fresh breeze from north-west; there were, however, symptoms of the wind drawing to the westward, and I shaped a course for Scilly instead of for the Land's End. Captain Oliver, of the *Dee*, hailed, 'How long do you intend steering on this course?' I replied, 'Till I make Scilly Light.' The wind freshened, the ship increased her speed to eleven or twelve knots, and the steam frigates were left far behind. We made Scilly Light, and bore up for the Longships, passing between them and the Seven Stones—passed up channel and ran into Hamoaze, the wind having drawn to the southward. The steamers had continued their course with sail and steam, and made breakers under their bows on the north side of Scilly, the light being eclipsed by St. Martin's Head. They backed their engines, shortened sail, and stood to the north-west till daylight, when no three-decker was to be found! They searched the rocks in vain, and proceeded to Plymouth, alarmed for the safety of the *Royal William*. It now turned out that *their compasses* indicated a course that ought to have carried the steamers far to the westward of the Scilly Islands; the *north point of the compass was drawn forward by the influence of their machinery.*

"I had occasion to return to Pembroke to bring round another line of battle ship, taking a passage in the steam frigate, *Salamander*, commanded by Captain Austin. The adventure of the *Royal William* induced us to make many observations upon the local attraction of the steamer during the passage. A dockyard sailing vessel was taken in tow, and, after rounding the Land's End, we shaped a course *for St. Ann's Point*, (with a firm conviction, on my part, of making St. Govan's Head.) The wind shifted to the south-west, with thick weather; and as we neared the Welsh coast we were amused as well as *instructed* by the master of the vessel astern, standing up and waving his hat to steer more to port. He actually cast off the tow-rope and hauled up two or three points. We went on as before, and, as was expected, made St. Govan's Head *south-east from St. Ann's Point*. The master of the lighter knew from *his compass* that we were steering too far to the eastward. *Our* object was to prove how little dependence may be placed on the compass of a steam-vessel, when the local attraction is not known."

A large body of other evidence to the same effect has been collected by Captain Johnson, the Superintendent of the Compass Department of the Royal Navy, and published (1847) in his "Practical Illustrations on the Necessity for ascertaining the Deviations of the Compass." Captain Johnson arrives at this general conclusion:

"That in all vessels where the *deviation* has not been ascertained, the courses steered by compass are not the correct magnetic courses, or those inserted as such in charts and sailing directions; consequently, in such vessels, a course cannot be accurately shaped from port to port, *not even from buoy to buoy*."

But the degree of variation is in no two vessels alike. The system, therefore, on which the Compass Committee now proceed, and which is ably advocated by Captain Johnson, is to ascertain, by actual experiment, the amount of variation* produced in the compass of each vessel by the iron on board of it when fixed in the place it is intended permanently to occupy, and then to allow for the variation in all subsequent reckonings. The Captain illustrates the necessity for this by three Tables. Table I. exhibits the "deviations of the compass ascertained by actual observation on

* By the term "deviation" is understood the error of the compass produced by the iron in the ship, which is a thing altogether independent of the *variation*.

board fifteen of Her Majesty's *steam-vessels*;" Table II. the like, "ascertained by actual experiment on board of fifteen of Her Majesty's ships of war, of different rates;" and Table III. the like, "ascertained on eleven of Her Majesty's iron steam-vessels." He then shows, by reference to a chart of the English Channel, on which different positions are assigned to the thirty vessels, "what would inevitably be the result if they were placed in the positions there pointed out, and steered for the mouth of the English Channel according to the respective compasses, but without their commanders having a knowledge of, or making any allowance for the deviation."

"The correct magnetic compass, or compass course (1846) from the position A (diagram 1) lat. 48° 0′ N. and long. 11° 0′ W. to the mouth of the English Channel, half way between Ushant and the Scilly Islands, is E. ¾ S.; consequently, ships in which there was no deviation, steering that course, would be, after a run of twenty-four hours, only at the rate of ten miles an hour, on the fair way between the French and English coasts; but mark what would inevitably be the result if the vessels named in the Table were to be steered in the same course, that is, E. ¾ S. *according to their respective compasses*. The *Gorgon* would be among the rocks off Ushant; the *Retribution* and *Vesuvius* would be steering directly for the dangers about the Seven Isles; the *Stromboli*, *Geyser*, and *Styx* would be advancing upon the "Roches Douvres;" while the *Terrible*, *Penelope*, *Sampson*, and *Cyclops* would be in a direction for the dangers about Jersey and Guernsey; and the *Victoria and Albert*, *Blazer*, *Porcupine*, *Black Eagle*, and *Albion*, from having less deviation upon that particular course, would be nearer to the fairway; but not one *vessel of the fifteen would be in the position which the compass course, corrected for deviation, would lead their commanders to suppose themselves in.*

"Referring to Table III., which contains the deviations ascertained on board several iron steam vessels, and also referring to the double lines upon the charts, it will be seen that, even in the short run of twenty-four hours, the *Princess Alice*, *Bloodhound*, *Myrmidon*, and *Jackal* would be upon the coast to the southward of Ushant, while the *Dover* and *Onyx* would be steering towards the Lizard; thus spreading the angle of the deviations over the entire space of ocean between England and France, and that, too, in a run of twenty-four hours only, and in vessels where the greatest care was taken in elevating and placing the compasses, and also in removing all ironwork from their immediate vicinity.

"* * * To show the utter impossibility of navigating iron ships without the most systematic and constant precaution, one fact in proof thereof may be mentioned, viz., that when the *Onyx's* head was at north (correct magnetic), the binnacle compass in front of the wheel indicated it to be S. E.!

"* * * Let us now suppose the distance of this fleet (the fifteen men-of-war), accompanied by steam-vessels (Table I.), to have been double that which it was before, or, in other words, forty-eight hours' run instead of twenty-four (and there is assuredly nothing improbable in assuming forty-eight hours—continuous hours—of thick weather often to prevail in our humid climate), and the result would be, that the course E. ¾ S., according to their respective compasses, would lead some of the sailing ships towards the French coast; the *Penelope*, *Styx*, *Stromboli*, *Vesuvius*, and *Retribution* far to the southward of Ushant; the *Gorgon* to the south part of Hodierna Bay; while the iron steamers *Princess Alice*, *Bloodhound*, and *Myrmidon* would be as far *south* as Quiberon, the *Dover* as far *north* as the Scilly Islands—in short, running directly for them—and the *Onyx* actually passing them yet farther to the north, and steering in a direction for the Bristol Channel.

"Be it observed, that the above reasoning obtains from the results ascertained with standard compasses, carefully placed in the midship line of the different vessels, and as far removed as was practicable from ironwork likely to affect the magnetic needles; and it is, therefore, probable that vessels navigated with binnacle compasses only, would have the errors increased by reason of their nearer proximity to the guns and iron work.

"The lines in diagram 2 show the divergency of each vessel, when steered a compass course uncorrected for deviation. * * * By this diagram it will be seen that some of the vessels, having large deviations, would be involved among the dangers and intricacies of the Channel Islands in less than the short period of twelve hours; and, pursuing the track of the others higher up, one cannot help remarking how easily mistakes may be made, and how vessels may be brought upon the coast of France in such a way as to puzzle those in command as to the lights seen; and this not only by reason of the deviation of the compass, but also when approaching the narrower parts of the channel, from the proper distance having been overrun before the vessel's course was changed."

The Admiralty system of ascertaining the amount of deviation caused by the

iron in each vessel, and making allowance for it afterwards, judicious as it must be allowed to be, is, nevertheless, calculated to induce a degree of indifference about the improvement of the instrument itself, since a large deviation can as readily be made allowance for as a small one. Of any such indifference, however, the Compass Committee cannot be accused. The work of Captain Johnson contains abundant proofs of a most laudable anxiety, and of much painstaking on the part of the Committee, to render the instrument as perfect as possible. Among the "prominent sources of error" in compasses (exclusive of the local attraction of the vessel), the following prevalent defects of the instrument are pointed out by the author:

"4. The weakness of the magnetism of their needles, the occasional oblique direction of the magnetic axis in such as have flat bars, the distension of the compass cards, the imperfection of their pivots and caps, inefficient suspension and balancing, and the want of concentricity in the general construction of the instrument."

So true are these things of the generality of instruments, that on Professor Barlow being requested to examine the state of the compasses kept in store by the Admiralty, he reported (1820) that "more than one-half of them could but be considered as *mere lumber!*"

Whoever, therefore, can give us a compass free from such defects, must assuredly render a most important service to the country. Now, this is what Mr. Bush professes to have done in the patent instrument which we are now about to describe. "According to my invention," he says, "the local attraction consequent on there being quantities of iron and other causes acting near the compass, is caused to be centralized in or near the axis of the motion of the needle, whereby the needle of a compass is less prejudicially influenced, and will, consequently, act with more correctness, and, in fact, will be more similar in its performance and pointing to what would be the case were there no iron or other causes of attraction in the locality in which a compass may be placed." According to his invention, too, the needle is so nicely balanced—the points, caps, and supports all so accurately adjusted—that nothing can well exceed the truth and delicacy of the movements of the instrument.

Fig. 1 of the prefixed engravings is a side elevation, and fig. 2 an end elevation, partly in section, of Mr. Bush's compass.

"A is a cistern of mercury, which sustains in an upright position a glass float (open to the air at bottom), to the top of which is attached by cement a vertical magnetic bar, C, which terminates at its upper end in a cup, *b*. D is a guide-tube, through which the bar, C, works up and down; EE are two longitudinal bars connected, at a short distance apart, by cross stays, from which spring four vertical bars, G^1, G^2, G^3, G^4 (the last of which is not seen in the figures), which are inclined inwards towards the top, and are, near to the top, united by a hoop, H. FF are two more longitudinal bars, which are placed immediately above the top ends of the vertical bars, G, and work on a gimble, J; K is a small framework, which is attached to the gimble, J, and carries, at the top of all, the card and needle, L. The longitudinal and vertical bars, E, F, and G, are all magnetic, and form a sort of framework round the central magnetic bar, C. The poles of the upper pair of longitudinal needles are placed in the reverse positions to those of the under pair. The vertical needles, G^1, G^3, have their south poles pointing upwards, and the vertical needles, G^2 and G^4, their north poles upwards. M is the pivot on which the card and needle turn; it is jewel-pointed, and works in an agate socket in the cup, *b*."

Mr. Bush's idea is, that the placing of the magnetic bars in the relative positions to the needle here assigned to them, must cause all the magnetic influence to which the compass is exposed, to concentrate itself in or near to the axis of motion of the needle. The theory of this is not very well made out in his specification; but certain it is that the practical effects—with which we have most to do—are singularly satisfactory.

Fig. 3 shows the comparative results of a trial made with one of the Admiralty standard compasses, and one on Mr. Bush's plan, by applying a bundle of steel bars to eight different points of the periphery of each, on a plane one foot below the plane of the needle, and one foot from its axis; the bars being first presented with their north pole to the needle, and then with their south pole. For example, the bars being pointed due west, the Government compass gave a variation with the north pole of 30° W., and with the south pole of 30° E.; while Mr. Bush's gave only 5° and 6°, making the average difference as 60 to 11. And so in every case, without exception, the difference was immensely in favour of the patent compass.

APPARATUS FOR HEATING IRON VESSELS PREPARATORY TO COATING THEM WITH MR. HAYS' COMPOSITION.

Sir,—Having occasion to use means for warming the bottoms of iron vessels, to prepare them for the preparation recommended by Mr. Hays, of Portsmouth, I planned a simple contrivance for applying the fire, which I think will be found useful to others under similar circumstances. The following sketches, with a word or two of explanation, will, no doubt, make it clear to any practical man:

Fig. 1.

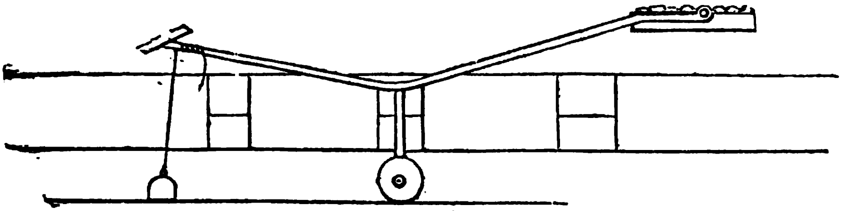


Fig. 2.

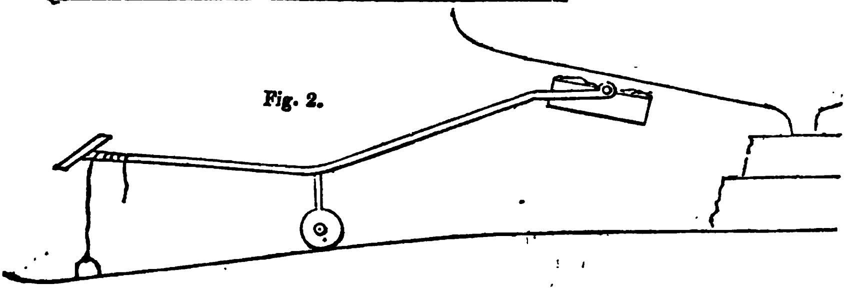
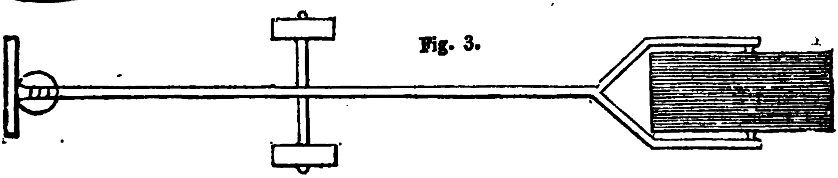


Fig. 3.



A large oblong pan is first made for containing the charcoal, its dimensions being about 3 feet × 2 feet: a stud projects fro·n each side, by which it is suspended to a carriage, made of a long bar of iron, about 12 feet long. This bar is divided at one end, and has a handle at the other: the centre of the bar is supported on two small truck wheels. The general form is shown in the engravings. Fig. 1 shows the carriage, with the bar in the direction of the keel of a vessel in the dry dock; fig. 2 shows it in a transverse position. Fig. 3 is a plan of the carriage; a weight, with a cord attached to it, is employed at one end. The man, having wheeled the apparatus to its proper position, attaches the weight to the handle, by which contrivance he is enabled to leave it for a few minutes and attend to another, which he places in a similar manner, thus alternately shifting them to fresh parts of the vessel.

This contrivance is only intended for the bottoms of the vessels, the sides being heated by the pans adopted by Mr. Hays.

I may remark, that this simple apparatus will be found very useful for drying iron vessels previous to painting them, both inside and out.

I am, Sir, yours, &c.,
JOHN GRANTHAM.

Liverpool, April 4, 1848.

ON THE INFLUENCE OF RAPID MOTION OF THE PISTON UPON THE EFFECT OF STEAM IN ENGINES WORKING EXPANSIVELY: WITH EXPERIMENTS UPON THE SUBJECT. BY M. PALTRINERI.

The researches and numerous experiments which I have made upon the application of motive power to machines, and particularly my experiments upon the effect of springs, have convinced me that in the expansion of steam there is a loss of power—a loss which should have a certain relation to the number of superimposed strata of steam which occupy the cylinder, from its bottom to the piston. These strata, moving with the piston, should naturally develop themselves, in order to follow and push it; and it is in this development of strata, one after the other, that the steam must employ a portion of its force—a portion which is certainly lost to the engine. The greater the number of strata, the more rapid is their development; and the more power that is thus absorbed, the less will there remain for useful effect.

Suppose the steam introduced into a cylinder to be intercepted at the moment when the piston has reached a fourth or a third part of its stroke, to give place to the expansion: from this moment we may imagine the fluid mass divided into a determinate number of successive parallel strata, and beginning to develop and expand themselves to drive the piston and follow it. It will then be apparent that the stratum nearest the piston will, without doubt, be able to exert upon it all its effort, and all the rapidity of which it is capable; but it will be also apparent that the one which follows cannot do as much, because the preceding stratum constrains it, by pushing it backwards at the same time that it forces the piston forwards. By its condition as an elastic fluid, steam should naturally expand every way, and maintain at the same time, as is admitted, a uniform density throughout its volume—consequently, the stratum which drives the piston on one side, repels on the other, at the same time, the stratum which follows it, although allowing itself to be penetrated by it; the latter repels the one which follows it, and so on to the last, which is at the bottom of the cylinder.

There must, therefore, be a collision between one stratum and another, on account of the difference in their velocities, and of the necessary compenetration of one stratum into another, in order that the uniformity of density may be maintained. This collision must evidently produce a loss of power—a loss which should be proportional to the differences of the velocities, and which will be the more considerable according as the number of successive strata is increased, and as the expansion takes place more quickly.

It is from these considerations, confirmed by the results of experiments upon the effect of helical springs, that I am persuaded that a given quantity of steam, working by expansion, will produce more disposable and useful effect acting upon a piston of a large surface and short stroke, than upon a piston of smaller surface and with a stroke proportionably longer, all other circumstances being equal. Desirous of determining the truth of this opinion by rigorous experiment, I caused two steam-engines to be constructed under conditions strictly equal, and calculated to produce the same dynamic effect, according to admitted principles. But in one of them, the relation of the surface of the piston to the length of the stroke was in an inverse ratio to that of the other; that is, if one of the pistons had a surface of 20 and a stroke of 24, the other had a surface of 80 and a stroke of 6; so that the volume produced by the movement of one piston is precisely equal to that of the other. There is, therefore, exactly the same quantity of steam entering and leaving the two cylinders at each stroke of the piston, and, consequently, when the number of strokes is the same, in a given time, in each of the two engines, it ought to be certain that there is the same volume of steam, in the same physical and mechanical conditions, used by each cylinder. These experiments, of which a Table is given, were made with all possible precaution, in order that all the conditions of the apparatus should be identically the same; they were repeated several times, on different days, and in the presence of several competent persons. The following Table shows the mean of the results obtained in several series of experiments, the apparatus being always kept under the same conditions:

The numbers in this Table will show, at a glance, the difference of effect between the two engines. Although every precaution was taken to avoid error in the measurements and observations, and though the numbers in the Table only show the mean result of several series of experiments, I do not assert that the ratios there given are strictly those which should result from the physical law of this phenomenon. New experiments with engines of greater power, and an exact calculation with regard to the

No. of Experiment.	Kind of Cylinder.	Weight on the Brake.	Revolutions per Minute.	Virtual velocity of end of brake lever.	Pressure on Steam gauge.	Cut off, or space for expansion of Steam.	Effect in kilogrames raised 1 mètre per second.	Ratio of Effect between the two Engines.
		Kilogs.			Atmosph.			
1	Wide	1·814	150	7·854	$\frac{4}{10}$	Full of steam.	14·247	1·00
	Narrow	1·614	150	7·854	$\frac{4}{10}$	Full of steam.	12 676	·88
2	Wide	1·754	168	8·796	$\frac{9}{20}$	$\frac{1}{2}$	15·428	1·00
	Narrow	1·418	168	8·796	$\frac{9}{20}$	$\frac{1}{2}$	12·472	·80
2	Wide	2 127	174	9·110	$\frac{6}{10}$	$\frac{2}{3}$	19·376	1·00
	Narrow	1·277	174	9·110	$\frac{6}{10}$	$\frac{2}{3}$	11·633	·60
4	Wide	2·116	156	8·168	$\frac{8}{10}$	$\frac{4}{5}$	17·283	1·00
	Narrow	0·916	156	8·198	$\frac{8}{10}$	$\frac{4}{5}$	7·481	·43

results obtained, can alone establish, with the accuracy desirable, all these relations. I believe, however, that the reasoning upon which my opinion is founded, and the results of the experiments which go to confirm it, authorise me to make the following conclusions:

1. That the velocity of the piston has a much more remarkable influence upon the useful effect of steam than has been heretofore supposed.

2. That this influence is very greatly increased, and according to a certain ratio, on account of the amount of expansion which is allowed to the steam; the greater being the expansion, the greater is the difference of effect.

3. That in order to obtain from steam the greatest amount of useful effect, it is necessary to use cylinders as wide and short as may be practically convenient, and that the piston should move at a very low velocity.

It is certainly not unknown that the effect of steam has a relation to the velocity of the piston; but it has not yet, so far as I know, been recognised that the velocity of the piston has a particular and considerable influence upon the effect of the expansion; and I believe myself to be the first who has directed attention to this subject, and who has sought to demonstrate the truth by experiment. The numbers in the Table show, in effect, very considerable differences, although the velocities of the two pistons appear only in the ratio of 1 to 4. The experiments mentioned have manifested two other phenomena which have attracted my attention, and which I recommend to the notice of scientific persons: the first is, that in the engines which I used, and when they were worked by expansion, the pistons were compelled, in some of the experiments, to complete their stroke while having against them (on account of atmospheric pressure) a resistance stronger than the force by which they were impelled. The other phenomenon is relative to the work done by the two engines. In most of the experiments made, the useful effect, as measured by the brake, was always, and even considerably more than the theoretical effect of the motive power. Does this difference of effect depend upon the partial vacuum created in the escape-pipe on account of the rapid passage of the steam, so that the pressure upon the piston has a relatively greater force? May this rarefaction in the escape-pipe also account for the continuance in the stroke of the pistons, although they may have been placed in equilibrium by atmospheric pressure before making a half or two-thirds of their stroke?

All these questions, the importance of which will be readily perceived by men of science, have need of study and elucidation by experiments, perhaps of a different kind. On my own part, I shall do all that I can; but I call for the aid of learned persons who are conversant with such matters.—*Comptes Rendus*, Sept. 27, 1847.

ON THE IDENTITY OF MOTION AND CALORIC. BY M. SEGUIN.

In a work which I published in 1839, upon the influence of railroads, I advanced the opinion that steam was only the medium which is used for the production of force, and that reciprocally; and that there must exist, between caloric and motion, an identity of nature in such manner that these two phenomena are but the manifestation,

under a different form, of the effects of a single and the same cause.

These ideas were communicated to me, long ago, by my uncle, Montgolfier; and I only waited, before giving them publicity, until positive experiments and well established facts should give them the sanction of demonstration.

Under these circumstances I learned, by the *Compte Rendu* of the session of 23rd June last, of the experiments made by M. Joule; and found that the results which he had obtained gave so much force to the opinion of the celebrated man who had advanced the same ideas more than fifty years since, that I thought it my duty to submit to the Academy the important consequences which, it seems to me, may result therefrom.

In this article, M. Joule considers caloric as free from bodies, and demonstrates that the heat required to increase the temperature of one gramme of water one degree of the thermometer, is equal to a mechanical force capable of raising a weight of 430 grammes, one mètre in height.

Now, in regarding this question under a point of view altogether different from that of M. Joule, I have arrived at an almost identical result. Having supposed, in effect, that the decrease of temperature resulting from the expansion of a gas which extends itself throughout a space larger than that which it previously occupied, represented the mechanical force which then appeared; I calculated the number of kilogrammes of water that a cubic mètre of steam, at 180 degrees, (Centigrade,) could, by its expansion, elevate one mètre in height, according as its temperature decreased—and calculating the products for every 20 degrees, up to 80. In reducing my results to the type of one gramme raised one mètre in height adopted by M. Joule, and correcting them as regards the ratio of the specific heat of water to that of steam, I found that the amount of mechanical power developed by a gramme of water raised one degree in temperature, was as follows:

Between	180°	and	160°	=395	gr.	Mean, 449 grammes.
„	160	„	140	=412	„	
„	140	„	120	=440	„	
„	120	„	100	=472	„	
„	100	„	80	=529	„	

These results oscillate, as will be perceived, about the number 430, which was arrived at by M. Joule; and this notwithstanding, as I have said, that we are placed in an altogether different point of view. M. Joule has considered the caloric as free, and the pure and simple elevation of the temperature of water a certain number of degrees, in a thermometrical scale circumscribed between two or three degrees; while I have regarded the caloric as latent, or the variation of temperature which steam undergoes in passing from one state of pressure to another, and that within the most extended limits, inasmuch as they vary between 80 and 180 degrees, in which it is hardly possible to be certain that the thermometric scale, used to measure the temperature, really represents the quantities of caloric which it indicates. And it is from this, perhaps, that arise the differences of mechanical power developed by steam, between the two extremes of the scale of results which I have obtained—results which would have presented themselves in a very different manner, and even, perhaps, in an inverted sense, if, instead of mercury, a thermometer constructed of any other substance had been used—the expansion of bodies, according to the variation of their temperature, being, possibly, a property which is not subject to the same law as that of the amount of mechanical power which they then develop.

If, in conjunction with these facts, we consider a great number of others in which caloric is known to be produced by motion, such as percussion, compression, friction—change of condition, or of nature; we shall be convinced that the two phenomena, identical in themselves, are but the consequences of a general law which governs the movement of all bodies; and that the phenomena which we designate under the title of *caloric*, are nothing but the effects of the communication of motion of bodies among themselves, when they are reduced to a state of division of which we cannot appreciate the intensity, or the circumstances, as we are able to do when these same bodies have, in mass, a movement which may be measured by the sensible effects which it produces.

I shall not undertake to enumerate all the consequences which would result from the adoption of this principle, and chiefly the modifications which it would produce in the application of steam to the production of power.

In steam engines of medium pressure, which are those presenting the most advantages, the steam is used between the limits of pressure which I consider equal, approximatively, to a reduction of 80 degrees of temperature, after which the elasticity of the steam is destroyed by condensing it, or it is allowed to escape into the air. But it is evident that, in this state, the steam still contains 630 degrees of heat which is not made useful, and that we might, by continually using the same steam, and restoring to it at each stroke of the piston the quantity of heat which has been lost in the act

of producing the motion, obtain results which would bring about a complete and immense revolution in this department of mechanics, which has become so interesting at the point of civilisation to which we have now arrived.

With the view of explaining facts which, at the first glance, appear so little to be derived from the same source, and of which it will be so important to give an explanation, showing that they class themselves naturally under the law of universal gravitation, I have undertaken a work which I propose to submit to the Academy as soon as it may be in a sufficient state of forwardness to merit serious attention from them.—*Comptes Rendus, Sept.* 20, 1847; *as translated in the Franklin Journal.*

AN EASTERN FOUNTAIN.

The Vale of Sharon is an immense meadow, extending from Mount Carmel to Joppa on the coast, and bounded on the east by the great chain of barren-looking hills, among which is situated the Holy City. It is an area of perhaps twenty miles square, of beautiful rich lowlands, planted, in many places, with olive and fig-orchards, and grazing plats, upon which herds of goats and cattle were browsing. In all this beautiful valley there is not a single fence or wall, and the park-like effect of the groves and valleys is very lovely. It struck me that, in the hands of skilful husbandmen, it might be a paradise. Several Arab villages of brown mud cottages, with tall date-trees intermingling, and ruins of ancient elegance, as arches of aqueducts, fountains, and causeways, are scattered over the plain; and huge reservoirs of water, with convenient fountains for the traveller, are pleasant, shady spots, which the lingering heat of the sun made exquisitely welcome to us. There is no feature of eastern scenery so beautiful as these fountains, generally of solid masonry, with arching domes, and deep niches, huge stone basins, and cool porticoes, with carved stone ottomans, upon which the weary pilgrim may freely repose his limbs; large carob-trees and thick shady figs spread their huge limbs over the approaches, and the cool shade is dark and pleasant from the garish sun. We had ridden six miles when we arrived at the second of these diamonds of the plain. We found a small caravan reclining under the trees; the camel-drivers were adjusting the panniers, urging the patient beasts to lift their huge forms, and low, melancholy cries were groaned forth as they rose under their burdens. A herd of goats, probably two hundred in number, was also just leaving the fountain to continue their way towards Jaffa; and the swarthy, half-naked herdsmen were occupied in keeping the flock together on the way. Arab women were drawing water, and carried Rebecca-looking jars on their heads. Several dismounted Arabs reclined under the cool portico; and the whole picture, in architecture, costume, habits, and scene, was unchanged since 1800 years. Our Arab guard came first along, and took their position a little beyond the pools; the officers came in turn, drew out their drinking cups and flasks, and man and beasts took long and copious draughts of the refreshing springs. This fountain has left delightful impressions: it was a gay and joyous pausing place; and eyes fond of pictures, and hearts fond of recollections, had ample occupation.—*Shores of the Mediterranean, by Schroeder.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Eugène Ablon, of Panton-street, Haymarket, for improvements in increasing the draft in chimneys of locomotive and other engines. April 8; 6 months.

Thomas Gill and John Edgcumbe Gill, of Plymouth, manufacturers, for improvements in the manufacture of manures. April 8; six months.

Thomas Potts, of Birmingham, brass tube-maker, for improvements in the manufacture of tubular flues of locomotive and other steam boilers. April 10; six months.

Thomas Spencer, of Prescot, Lancashire, for certain improvements in machinery or apparatus for manufacturing pipes and tubes from clay or other plastic materials, part or parts of which improvements are applicable to the manufacture of hollow earthenware. April 10; six months.

James Derham, manager of Thomas Willett and Co.'s spinning-mills, Bradford, Yorkshire, for certain improvements in machinery for carding, combing, preparing, and spinning cotton, wool, Alpaca mohair, flax, silk, and other fibrous materials. April 10; six months.

John Ecroyd, of Rochdale, Lancashire, machine-maker, and John Eccles, of the same place, mechanic, for certain improvements in valves or plugs for the passage of water. April 10; six months.

James Perrie, of Rochdale, Lancashire, engineer, for certain improvements in steam-engines. April 10; six months.

John Longworth, of Newton-heath, Lancashire, for certain improvements in pickers for power looms. April 10; six months.

James Meacock, of Liverpool, gentleman, for improvements in preventing and extinguishing fire in vessels, warehouses, and other buildings, parts of which improvements are applicable to ventilation. April 12; six months.

John Masters, of Leicester, gentleman, for improvements in dress fastenings and in attaching the same, and in articles made wholly or in part of certain flexible materials or fabrics. April 12; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
April 7	1411	Joseph Pimlott Oates..	Lichfield...........................	Diaphonous valve for the cornopean and other wind instruments.
8	1412	Francis Bassano........	Birmingham........................	Signal lamp.

Advertisements.

NOTICES TO CORRESPONDENTS.

Mr. J. Clarke.—*Yes.*

J. W. M.—*Had better apply to some respectable coach maker.*

Artizan.—*We shall be glad to receive the "New Rule" he speaks of.*

"A Practical Man who knows the Value of Science" *does not make sufficient allowance either for the feelings of the parties attacked, or for the indulgence which is due from an editor to a party defending himself to the best of his ability and after his own fashion.*

CONTENTS OF THIS NUMBER.

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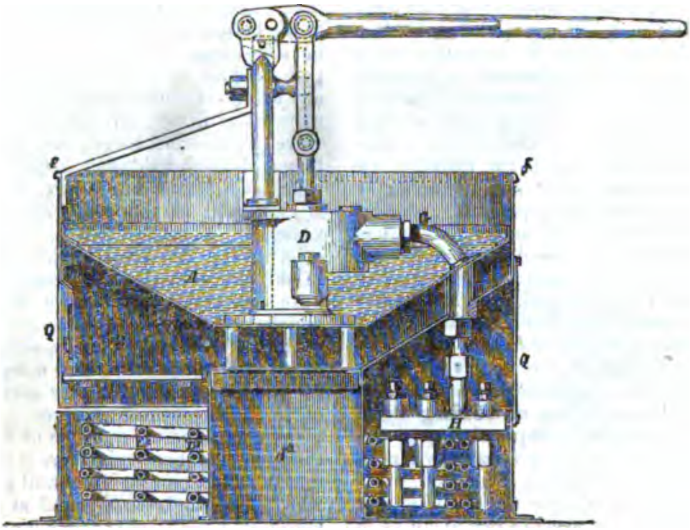
Edited by J. C. Robertson, 166, Fleet-street.

MR. MAUDSLAY'S IMPROVEMENTS IN THE MANUFACTURE OF CANDLES AND OTHER MOULDABLE SUBSTANCES.

Fig. 1.



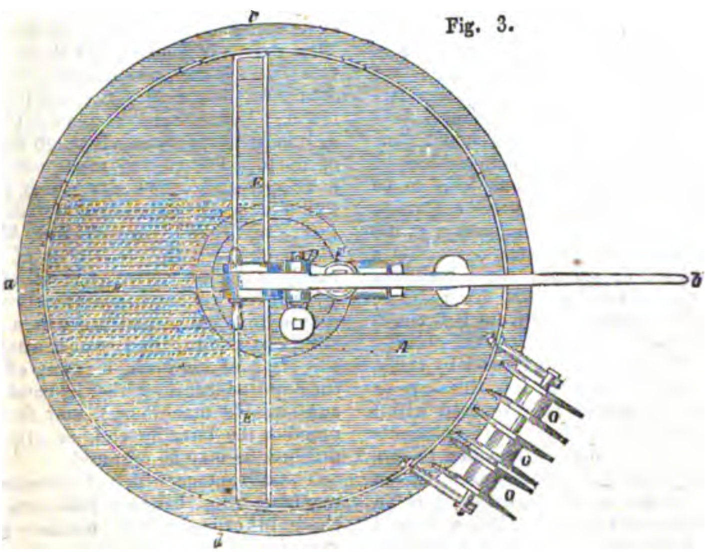


Fig. 3.

MR. MAUDSLAY'S IMPROVEMENTS IN THE MANUFACTURE OF CANDLES AND OTHER MOULDABLE SUBSTANCES.

[Patent dated October 14, 1847. Specification enrolled April 14, 1848.]

The improved system of manufacturing candles, which forms the subject of this patent, consists in moulding them by the continuous forcing of the tallow, or other substance of which the candles are composed, through pipes kept at a low temperature, such tallow or other substance being in a warm and fluent state when it enters the pipes, but becoming gradually and partially solidified and crystallized in its passage through; and in finally cooling and hardening it, by discharging it into cold water (the cotton for forming the wick being introduced into the tallow as it passes through the pipes). Mr. Maudslay states that he is aware that it has been before proposed (alluding, we presume, to the patent of Mr. Fennel Allman, 1847,) to make candles by the continuous forcing of the materials through pipes, but *in a cold or solid state only*—"a method which," he correctly adds, "has been found objectionable, on account of the impossibility, of effecting more than a mechanical compression or crushing together, of the materials while in that cold and solid state."

A machine suitable for carrying out Mr. Maudslay's mode of manufacture, is represented in the accompanying figures. Fig. 1 is a sectional elevation of this machine on the line *ab*, and fig. 2 another sectional elevation on the line *cd*. Fig. 3 is a plan on the line *ef*, and fig. 4 a plan on the line *gh*. A is a close vessel of a cylindrical form, with conical bottom, for containing the melted tallow or other substance or composition of which the body of the candle is to be formed. A^2 is a circular basement which supports several short pillars, *p*, *p*, on which the vessel A is mounted. B is a small stove or furnace, by which the vessel A is heated, and CC a flue-space, by which the heated air from B is circulated round the vessel A. (The melting vessel, A, may also be heated by steam or hot water, in which case the stove or furnace, B, would be dispensed with.) A chimney, for carrying off the products of combustion, may be attached to any convenient part of the flue-space, C, but is not shown in the figures. I is an open cylindrical vessel, filled with cold water, which surrounds and is concentric with the basement, A^2, but is a few inches less in height, and is connected to the melting vessel, A, above, by side bars, QQ, which are made fast by bolts and nuts. D is a force-pump, of the plunger description, which stands within the melting vessel, A, being firmly bolted to the bottom of it, and farther secured br side-stays, EE. By working this pump (which may be done by hand, or any other convenient power,) the melted material is drawn through the suction-valve, F, into the barrel, and is forced thence through a side discharge-pipe, G, which conducts it into a box, H, which is immersed in the cold water of the vessel, I. From this box proceed three coils of pipe, L^1, L^2, L^3, which are laid in the cold water of the vessel, I, and have screw-taps attached to them, by which they may be all opened to the passage of the melted mass, or any one or two of them only, the mass being pressed forward, as the case may be, in one, or two, or three columns. At the point, *m*, near to the extreme or delivery end of each of these coils, there is inserted into the top of each coil a small pipe, P, which is turned short round at the inserted end, so as to terminate exactly in a line with the centre of the coil; and through this pipe a string of the cotton or other material which is to form the wick, descends from one of three reels, O, O, O, which are mounted in brackets attached to one side of the melting vessel, A. The column of plastic matter, as it is pressed forwards through the end of the coil towards the mouthpiece, M, envelopes and draws along with it the string of cotton or other material. On emerging from the mouthpiece, M, the plastic mass, with the string of wick inside, is discharged into a vessel of cold water, N, where it speedily becomes thoroughly cooled, and acquires a crystalline hardness. As fast as it attains to this state of hardness, it is cut off into the required lengths (either by hand or by any suitable machinery), and then tapered at the burning end, or otherwise finished, as may be required.

The advantage which this method of manufacturing candles possesses over those in ordinary use, consists in its great facility, expeditiousness, cheapness, adaptation to general use, and peculiar

fitness for colonial purposes; the machine being light and portable, simple to work, and not easily put out of order.

The number of coils in each machine must always bear a due proportion to the size of the machine, and of the pump more especially; and, although three are supposed to be employed in that before described (as a good medium number), Mr. Maudslay desires it may be understood that he does not limit himself to any particular number.

Fig. 2.

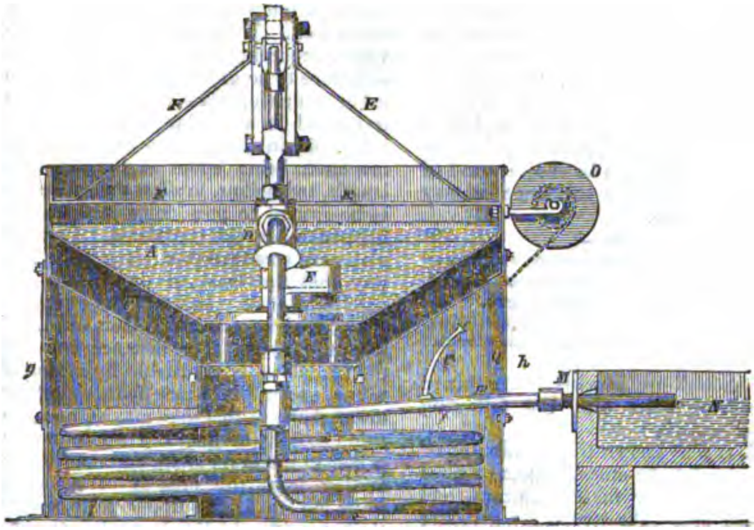
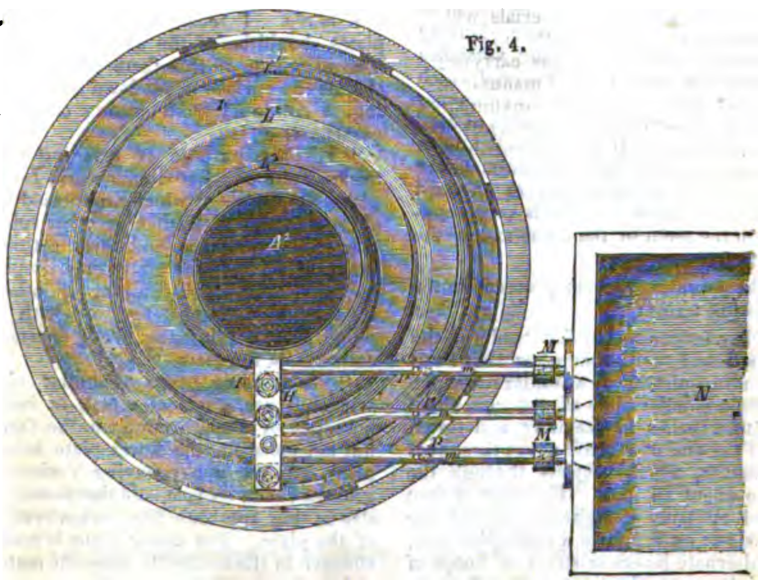


Fig. 4.



Wax, and other like materials, may be also manufactured by means of the same machine, and in the same way as before described, into tapers of any

required length, diminishing only the length of the pipes employed.

Mr. Maudslay states that the machine before described may be also readily modified so as to be made applicable to the manufacture of other mouldable substances besides candles,—that is to say, in so far as regards the shaping or moulding thereof—such substances, for example, as soap or syrups; but, instead of being discharged into cold water, as before described, they are received from the pipes or moulds upon an endless band of cotton, wire, or other substance, as may be most suitable.

MR. NEWALL'S PATENT IMPROVEMENTS IN MACHINERY FOR GRINDING GRAIN, PAINT, AND OTHER SUBSTANCES.

[Patent dated October 14, 1847. Patentee, Robert Stirling Newall, of Gateshead. Specification enrolled April 14, 1848.]

Mr. Newall prefaces his description of his improvements with the following general remarks:

"It is well known that 'mill-stones' are made of buhr-stone, a form of silica which is cellular in its structure, and that the best buhr-stones for grinding corn have about an equal proportion of solid matter and of vacant space. During the process of grinding, the vacancies soon get filled up with the material which is being ground, and in this manner there are formed alternate spaces of hard and soft matter. It is also well known that the grinding teeth of animals are composed of alternate layers of hard enamel and soft bone; this is very apparent in the teeth of the horse and of the elephant."

The specification then proceeds in the following terms:

"My invention has for its object the formation of 'mill-stones,' or what I call 'grinding-plates,' on a similar principle. I take a circular plate of cast-iron, about eighteen inches in diameter, and fasten it on the end of a shaft about three feet in length, which projects through the plate about an inch. The plate is then faced up truly at right angles with the shaft, and on it I form a tight spiral roll, of alternate layers or strips of hoops of steel, iron, or other metal, (but I prefer steel,) and of coarse paper, cotton, braid, or other suitable substance, the hoops being about an inch and a half in width, and about one-sixteenth of an inch in thickness; and the pitch of the spiral next the centre of the plate being about one-sixteenth of an inch, and gradually decreasing to within three inches from the circumference, which latter space is kept at a pitch of about one-hundredth of an inch. These proportions must be varied according to the nature of the substance to be ground. This forms the lower or driving plate. The upper one is formed in a similar way, the spiral being laid in the reverse direction, and the shaft being about eight inches in length, and hollow, to allow the substance to be ground to pass down it from the hopper to between the plates. The two plates are arranged in a frame in such a way that the faces of the spirals are parallel to each other, and the centre of one plate distant about an inch and a half from the other. The distance between the two plates is adjustable by means of a key under the brass footstep of the lower shaft, so that they may be made to grind coarser or finer. I apply motive power to the lower shaft, and the friction arising from the process of grinding gives motion to the upper plate, which then revolves in the same direction as the lower. I recommend that both plates should be of the same diameter. The advantage of this form of plate is, that as the surface wears down in grinding, a continual fresh cutting edge is presented.

"For the purpose of grinding the husk off rice or other similar work, I use plates the spirals of which are formed of alternate strips of leather or other suitable elastic substance, and thick cotton, braid, or felt; or the plates may simply be faced with thick leather, or other suitable elastic substance, or with a tough fibrous substance, firmly fastened endways on the plate.

"For grinding paints or similar substances, I use plates of metal, or hard porcelain or glass, ground on the face, but not polished, the lower plate being plain, and the upper having V-shaped grooves cut in its face, and decreasing in size as they approach the circumference of the plate. The upper plate is made concave in the centre, to allow the material to be ground to get between the plates, the concavity being greatest in the centre, and gradually tapering off to the extent of one-third of the radius, where it ends.

"Instead of combining in the shape of a spiral, the hard and soft materials of which these grinding-plates are composed, they may be put together in any other form; as, for instance, they may form the radii of a circle; or, the plate being divided into six or more segments, by lines radiating from the centre, the hard and soft materials may be arranged in lines parallel to those radii, until each segment of the plate is filled up.

"I do not confine myself to any particular arrangement of the grinding surfaces, but I prefer the spiral, as it is most easily made, and forms an excellent surface. The speed for dry substances may be from two hundred to three hundred revolutions of the plates per minute, and for semi-fluids, from one hundred to two hundred revolutions per minute.

"What I claim as my invention is, firstly, the combination of hard and soft materials for grinding surfaces, as described; secondly, the arranging of two plates, so formed, in such a way that they are eccentric to each other; thirdly, the arrangements of plates for grinding paints or similar substances, as described."

FORCE OF LIGHTNING.

[From a paper on Atmospheric Electricity. By E. Highton, Esq., C.E. Read before the Society of Arts.]

To many persons an attempt at comparing the wild, irresistible, and instantaneous action of lightning with the strength of the docile horse, or the power of the hard-working steam-engine, may seem to border on absurdity; but, when the same is once brought by the hand of science under the powerful dominion of mathematics, all is plain and clear. The lightning is at once robbed of its awe-striking properties, and shown to be subservient to many of the common rules in nature. It laws may then be studied with the same degree of certainty and accuracy as those that guide the stars above, and keep the planets in their course.

For simplicity's sake, I will take the power as developed in the spire of the Church only;* and this will have to be ascertained by the work of destruction wrought therein.

I find, from measurement and calculation, that no less than *one hundred tons of stones were blown down*. I find, also, that the average distance to which this mass was projected was about 30 *feet*.

Here, then, we have two, but only two, of the elements of a power, viz.: *Weight* moved, and *space* through which it was moved. Our only other desideratum is the *time* during which the power generated was acting. This, however, is a much more difficult question. The way I propose to deal with it is as follows:

The falling mass was, as it has been already observed, projected in all directions from the central line of the spire as a centre. The average height from which the falling mass descended was about 132 feet. The time required for a body to fall, by the force of gravity, through that distance is nearly three seconds. In this time, then, the body had been projected laterally 30 feet. The time therefore occupied by the projection of the mass 30 feet must have been three seconds also. Now, although this is the whole period occupied by the transit of the mass, it must not be taken as the time that *the power was acting upon it*. This, no doubt, did not exceed the time that the body moved through a foot, or even 6 ins.; for then so many crevices and cracks would have been formed by the bursting out of the stones, that the expansive power of the air within would have escaped through these openings. And moreover, all the windows in the spire were either quite open to the air, or had open-work leaden fronts.

On these data, then, the problem resolves itself into this—To find the nominal amount of a power that shall by its continued action over 6 inches or a foot, or say for $\frac{1}{10}$th of a second of time, move from a state of rest 100 tons, and give them a velocity of 10 feet per second. I find that the force of gravity acting for $\frac{1}{10}$th of a second of time, would generate a velocity of $3\frac{2}{10}$ feet per second. If, then, this power acted even for $\frac{1}{10}$th of a second, it must have been three times greater than gravity. If for a longer period, its power would be less; if for a less period, then its power would be greater. Again, I find that 100 tons were projected with an average velocity of 10 feet per second; and we know that a body, under the influence of gravity, would acquire such a velocity in about one-third of a second of time, and that the space fallen through in that time would be, say 2 feet; for, from the laws of gravitation, we have

$$V = T \times 32.16 \therefore T = \frac{10}{32.16} = \text{nearly } \tfrac{1}{3} \text{ second and}$$

$$S = T^2 \times 16 = (\tfrac{1}{3})^2 \times 16 = \tfrac{1}{9} \times 16 = \tfrac{16}{9} = \text{nearly 2 feet.}$$

* The writer here refers to St. George's church, Leicester, which was struck with lightning Aug. 1, 1846.

The power, therefore, to resist such a force continually must be able to lift 100 tons 2 feet high in $\frac{1}{6}$ of a second of time, or 100 tons × 2 feet × $\frac{1}{6}$ second. And reducing this to feet, we have, 100 tons × 2 feet × $\frac{1}{3}$ = 100 tons × 1 foot × $\frac{1}{6}$ seconds; and reducing this again to minutes, we have it equal to 100 tons × 1 foot × 6 × 60 = 360,000 tons moved from a state of rest, and a velocity given to them of 1 foot per minute.

Again, it is well known that the friction, in moving masonry, is about equal to the weight of the superincumbent mass.

On the whole, therefore, we shall be quite safe in taking the work done as equivalent to 360,000 tons raised 1 foot high per minute. Therefore 360,000 × 2240 lbs. = 403,200,000 lbs. per minute $= \frac{403,200,000}{33,000}$ = 12,220 horse-power engine.

This, it will be observed, is on the supposition that the power acted for so long a period as $\frac{1}{6}$ of a second; and also, that it was only equal to the power of gravity.

Let us now look in another point of view at the case before us. Assuming that the effect was produced during the passage of the power from the end of the spindle of the cross to the first leaden window, a distance of about 50 feet; and taking the velocity of the power even much less than as shown by Professor Wheatstone, and considering the cloud to have been but one mile high, we shall have that distance passed over in a period $= \frac{1}{1,000,000}$ part of a second of time. In that time, therefore, power sufficient must have been given out to move from a state of rest 100 tons, and give them a velocity of 10 feet per second. Now, if we find what velocity a body would acquire when unsupported, and acted on by the force of gravity, for that period, viz.: $\frac{1}{1,000,000}$ second, we shall see that since (Space) ∞ (Time²) √ Space ∞ Time.

We have therefore

$$\sqrt{16} : 1 \text{ sec.} : : \sqrt{\text{space}} : \frac{1}{1,000,000} \text{ or } 4$$

$$: 1 \text{ sec.} : : \sqrt{\text{space}} : \frac{1}{1,000,000}.$$

Therefore $\sqrt{\text{Space}} = \frac{4}{1,000,000}$ and Space passed over $= \frac{16}{1,000,000,000,000}$ or the space passed over in that time would be $\frac{1}{60,000,000,000}$ part of a foot.

Its velocity at that point would be

$$\text{Vel.} = \frac{1}{1,000,000} \text{ sec.} \times 32 = \frac{32}{1,000,000} = \text{say}$$

$\frac{1}{30,000}$ part of a foot per second. Consequently a body acted on by gravity in the above time would move through the $\frac{1}{60,000,000,000}$ part of a foot, and acquire a velocity of $\frac{1}{30,000}$ part of a foot per second.

But the velocity given out by the action of the lightning in the same time was, upon an average, 10 feet per second; and, as powers are to each other in the ratio of the velocities they produce under the same circumstances, therefore,

The force of the lightning in this discharge : force of gravity : : $10 : \frac{1}{30,000}$: : $1 : \frac{1}{300,000}$: : 300,000 : 1

Thus the force of lightning in this discharge was 300,000 times greater than that of gravity! In this case, therefore, a pressure of at least (300,000 × 100 tons =) 300,000,000 tons was brought into action, to burst the spire to pieces. No wonder, then, that the damage was so great.

I will now compare the work done with the work of a battery. Dr. Faraday has proved that the decomposition of one single grain of water produces more electricity than is contained in the most powerful flash of lightning. If so, then must the decomposition of a grain of water produce indirectly as a minimum, a power of force equal to the moving of 100 tons from a state of rest, and giving them an average velocity of ten feet per second. This is its minimum. But from what I have said before, and from what is evident from an inspection of the parabolic curve that would be formed by the falling mass, it is certain that a power was developed which was very much greater. If, then, the conclusions of Professors Faraday and Wheatstone are correct, a power at least 300,000 times greater than that of gravity itself was given out in this flash of lightning; and, although so immense, yet equal only to the power which binds together the atoms of a single grain of water. This is a science fraught with interest, and deserves, indeed, our most serious investigation.

Having brought certain effects within the powerful grasp of mathematics, I will now give the converse, and show practical effects produced from an investigation into mathematical formulæ.

I have lately been conducting certain experiments on batteries.

I was induced to form a few batteries from the following mathematical formula, which is found to express the resistance offered to electric currents, and the work done thereby. The formula is

$$F = \frac{n E}{\frac{n D R}{S} + \frac{l r}{s}}$$

Where E = electro-motive force:
n = number of plates:
D = distance of plates:
R = specific resistance of fluid:
s = section of wire:
S = area of plates:
l = length of circuit:
r = specific resistance of wire:

In accordance with that formula, I constructed several batteries, one of which was of a size less than the $\frac{1}{40}$ of a cubic inch. This battery I found would, for a month together, ring a telegraph bell ten miles off.

I will now, however, make a small one in your presence; the smallest, perhaps, that many of you have ever seen. It shall expose a surface of only $\frac{1}{100}$ part of an inch; it shall consist of but one cell; it shall be less than $\frac{1}{10000}$ part of a cubic inch, and yet it shall produce electricity more than sufficient to ovecome all the resistance in my brother's patent gold-leaf telegraph, and shall work the same powerfully. It is, in short, a battery which, although it will go through the eye of a needle, will yet work a telegraph well.

THE POST-OFFICE SUPERSEDED.—BAKEWELL'S COPYING TELEGRAPH.

The Postmaster-General, Colonel Maberly, and Mr. Rowland Hill, may set their houses in order, and prepare to evacuate St. Martin's-le-Grand; for they will soon have to exclaim with Othello, "Our occupation's gone!" It seems, indeed, a hard case, after so much labour to improve the postal communications of the country, and after steam has done its utmost to hasten the mail-bags to all parts of the kingdom, that the well-planned arrangements and excellent machinery should come to nought: but even they must submit to fate and scientific invention.

Not many months have passed since we noticed Mr. Bain's ingenious marking electric telegraph, by means of which symbols representing letters of the alphabet are marked on paper by electricity; and we predicted that means would soon be found of transmitting along the telegraph-wires exact copies of written communications. What we then deemed probable has now been realised. We have this week seen a specimen of writing by the copying telegraph, invented by Mr. F. C. Bakewell, wherein words traced from the original were legibly copied on paper by an instrument that had no connection with the one to which the transmitted message was applied, excepting by the usual wires from the voltaic battery. The letters traced on the paper appear of a pale colour, on a dark ground formed by numerous lines drawn close together. The communications thus traced, we understand, may be transmitted at the rate of 500 letters of the alphabet per minute of ordinary writing; and were short-hand symbols employed, the rapidity of transmission would be quadrupled. When this means of correspondence is in operation, instead of dropping a letter into the post-office box, and waiting days for an answer, we may apply it directly to the copying telegraph, have it copied at the distant town in a minute or less, and receive a reply in our correspondent's handwriting almost as soon as the ink is dry with which it was penned. There are various means, too, for preserving the secresy of correspondence, the most curious of which is, that the writing may bo rendered nearly invisible in all parts but the direction until its delivery to the person for whom it is designed.

The operations of the copying telegraph are not limited to the tracing of written characters. Letter-press printing may be copied with even greater rapidity than writing, and fac-simile copies of the morning papers may thus be transmitted to Liverpool and Manchester long before the papers themselves are delivered to their readers in London. The means by which these astonishing effects are produced we are not at present permitted to state, as the invention is not yet protected; but we are assured that the method is simple, and that the mechanism is neither costly nor likely to get out of order. It is, indeed, one of the peculiar features of the copying telegraph that it cannot commit errors, because the communications it transmits are fac-similes of the original writing.—*Spectator*.

[If the reader will refer to the account given in this Journal of Mr. Bain's invention, (No. 1249,)—which was the earliest, and is still the most complete which has appeared—he will see that on the same principle on which symbolical representations of letters are transmitted by Mr. Bain's process, fac-similes of the letters themselves—no matter how crooked or crabbed—may be conveyed. Mystery, therefore, about the matter, there need be none. The only objection to such an extension of the system is the prodigious waste of time and trouble which must attend to it; for, after all, you cannot transmit the actual writing itself—the acceptance, for example, to a bill of exchange. We apprehend, therefore, that for anything which this new invention promises, the post-office authorities are but in small danger of being disturbed in their "occupation"—to no greater extent, at least, than they have been threatened already, by the general adoption of the short-hand system of Mr. Bain and the Electric Telegraph Company.—Ed. M. M.]

MR. W. B. JOHNSON'S PATENT IMPROVEMENTS IN LOCOMOTIVE ENGINES.—CONCLUDING NOTICE.

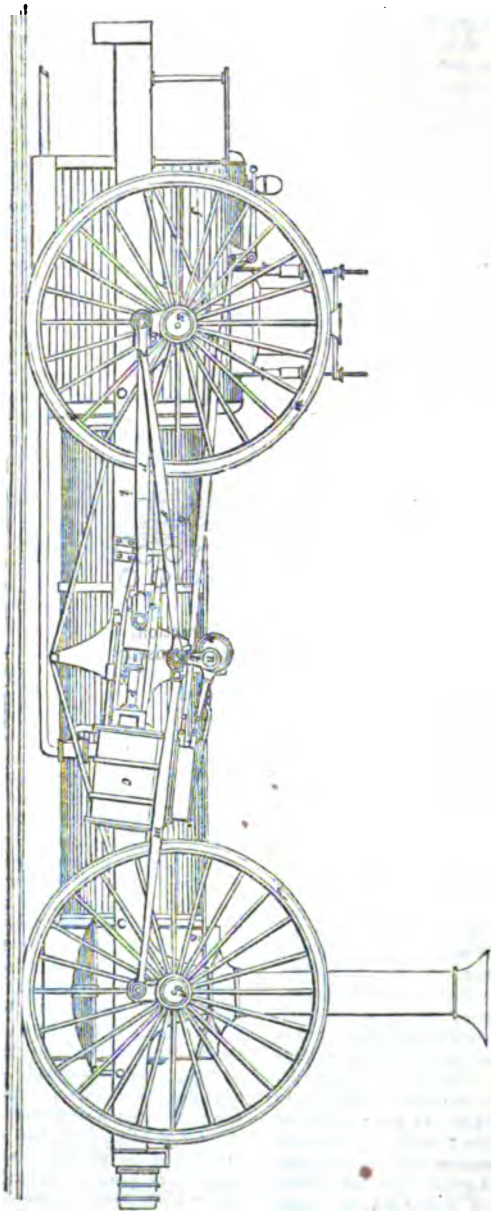
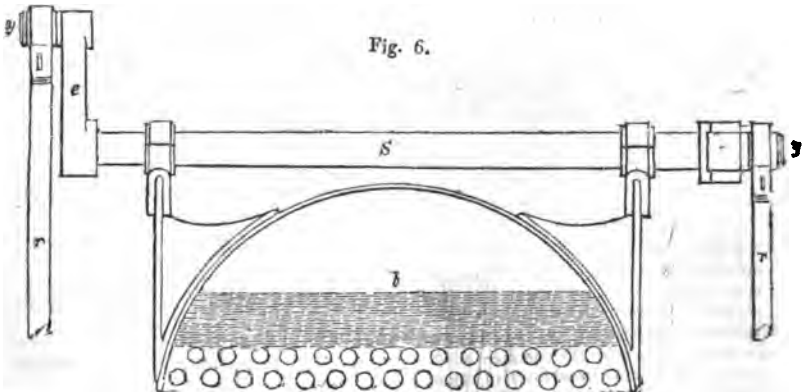


Fig. 16.

We extract from Mr. Johnson's specification the following description of his remaining improvements:

Fig. 6 represents an improved arrangement of working the eccentrics for giving motion to the slide valves or feed pumps, which is accomplished by carrying a shaft, *s*, over the boiler, *b*, (or, if required, it may be carried through a recess formed in the boiler,) upon the extremities of which shaft there are keyed two cranks, *c*, *c*, at right angles with each other, which cranks have a circular motion given to them by the two rods, *r*, *r*, which rods are connected with similar cranks upon the driving, or coupled axle of the engine; the eccentrics may be placed upon the shaft, *s*, either inside or outside of the bearings, *i*, *i*, when the relative positions of the eccentric shaft, and the shaft by which it is worked, are such as to form an angle exceeding 15° to 20°; it will then be necessary for the studs, *y*, *y*, to work in a slide formed in the direction of the cranks,

Fig. 6.



c, *c*, so as to allow for the varying distance of the two shafts by the action of the springs. The advantages of this arrangement are, that the eccentrics not being keyed or worked upon the driving axle, will admit of the boiler being brought nearer to the driving axle, and also to be made larger in diameter; the eccentrics being worked upon the shaft, *s*, are rendered much easier of access for cleansing and repairing, and constantly in sight of the engineman, and their durability is increased by being raised from the dust arising from the line of road.

Fig. 7 represents a side elevation of an improved eccentric; *s* is the shaft carrying the eccentric block, *b*; *r*, *r*, *r*, are friction rollers working in a groove formed on the rim of the block, *b*; the rollers, *r*, *r*, *r*, are kept in their proper positions by the two rings, *a* *a*, (fig. 8,) one placed on each side of the rollers, in which rings are formed the jaws, *i*, *i*, *i*, for receiving the brasses in which the axles of the friction rollers revolve; the usual eccentric rod, *o*, is attached to the rings, *a* *a*, as shown at *b′*. The advantages of this eccentric are, less friction in its working; the motion communicated to the valve, &c. is much steadier, as the eccentric rod is not liable to spring, as in the usual construction, less liability to disorder, and less expense in repairing, as the only parts

Fig. 7.

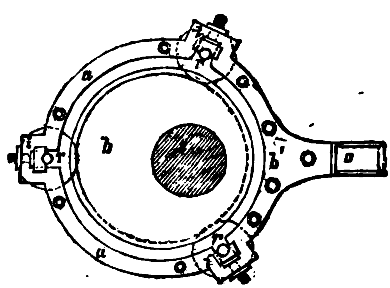
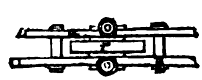


Fig. 8.



subjected to wear are the small brasses in which the friction rollers revolve.

Figs. 9 and 10 represent a longitudinal section and plan of an arrangement of valves whereby the steam is worked expansively,

Fig. 9.

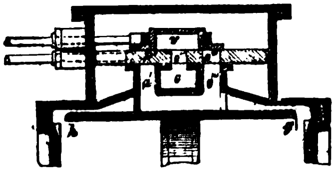
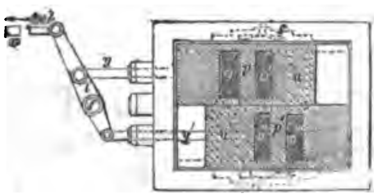


Fig. 10.



is cut off, and is reversed, or caused to act upon opposite sides of the piston. *v* is the usual slide valve working upon two flat plates, or valves, *p*, *p'*, which plates, or valves, are placed side by side, and are kept in close contact by the springs, *s*, *s*; these plates, or valves, have certain passages or openings, *o*, *o'*, *o''*, *o'''*, formed so as to agree with the passages or openings on the face underneath, which passages underneath are so divided, that the two passages, *o*, *a*, communicate to one end of the cylinder, *h*, and the other two passages, *o'''*, *a'*, communicate with the other end of the cylinder, *g*; *e* is the exhaust passage. From this it will be evident, that when motion, in the direction shown by the arrow, is given to the rod, *r*, (which rod communicates with the engine-man,) that the lever, *l*, working upon the fulcrum, *f*, will, through the rods, *y*, *y'*, communicate motion to the two plates or valves, *p*, *p'*, in opposite directions, by which the entrance of steam into the cylinder through the passages, *o*, *o'''*, can be regulated to any degree of expansion, or, by continuing the motion, be shut off entirely; and by continuing the motion so as to place the plates or valves in reverse position, the openings, *o'*, *o''*, will then allow the steam to pass through the passages, *a*, *a'*, and from thence to opposite ends of the cylinder, thereby reversing the motion of the engine. Therefore it is evident, that all that is required to work the engine expansively either backwards or forwards, to cut off steam, and to reverse, is, that the necessary motion should be given to the rod, *r*, communicating with the engineman. The advantages attending this arrangement of working the steam expansively, cutting it off, and reversing, are, simplicity in construction, requiring but one eccentric for each engine; the complicated arrangement for lifting the eccentric rods in and out of gear being entirely dispensed with, as, in this arrangement, the lifting of the eccentric rods in and out of gear is not required; the dispensing with the throttle valve; and the simple machinery required for working the valves, which places the entire control of the engine, as far as regards the operations just described, in one handle.

Figs. 11 and 12 represent a longitudinal section and plan of another method of working the steam expansively, shutting it off, and reversing. *v* is the usual slide valve working upon a fixed plate, *f*, which plate, or face, is kept in its correct position, by being fixed between the ribs, *r*, *r*; this face, *f*, has the usual steam passages, *s*, *s'*, and the exhausting passage, *e*; which passages,

Fig. 11.

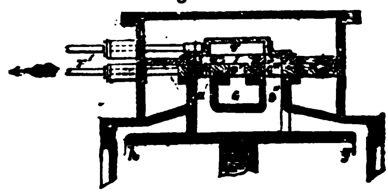
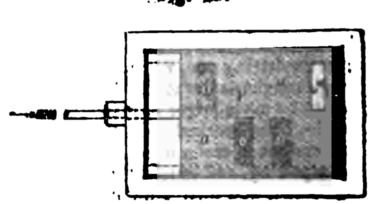


Fig. 12.



s, *s'*, and *e*, are divided in the centre by a rib of metal, so as to allow of the perfect action of the flat plate, or valve, *p*, working underneath this fixed face, *f*; this flat plate or valve, *p*, has certain passages or openings, *o*, *o'*, *o''*, *o'''*, (which are more fully shown in the plan, fig. 12;) this flat plate, or valve, *p*, works upon a face underneath, in which the passages are so divided as that the passages, *o*, *a*, lead to one end of the cylinder, *h*, and the passages, *a'*, *o''*, lead to the opposite end of the cylinder, *g*; *e* is the exhaust passage: from this it will be evident, that when motion in the direction shown by the arrow is given to the rod, *r'*, (which rod communicates with the engineman,) that the entrance of the steam into the passages, *o*, *o''*, leading to the ends of the cylinder, *h*, *g* can be regulated

to any degree of expansion required; and, if the motion be continued, so as to place the flat plate, or valve, *p*, in the centre of the valve box, the steam will be entirely shut off; and, lastly, by continuing the motion so as to place the plate, or valve, in the opposite end of the valve box, the openings, *o‴*, *o′*, in the plate, or valve, will then admit the steam through the passages, *a*, *a′*, and consequently to opposite ends of the cylinder, thereby reversing the motion of the engine. By this arrangement of valves, it is obvious that all that is required to work the engine expansively, backwards or forwards, to shut off the steam, and to reverse, is, that the necessary motion should be given to the rod, *r*, communicating with the engineman. The advantages attending this mode of working the steam expansively, shutting it off, and reversing, are similar to those named in the last-described method of performing these operations, with the additional advantage of always having presented to the face of the usual valve, *v*, a fixed face, *f*, to travel upon. The elevations of the engines, exhibited in figs. 15* and 16, have this arrangement of valves.

Fig. 13.

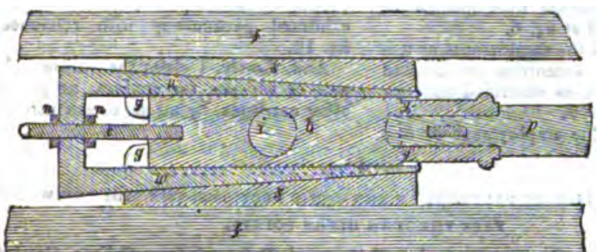
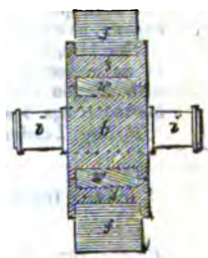


Fig. 14.



Figs. 13 and 14 represent longitudinal and cross sections of an expanding slide or guide-block; *p* is the piston-rod attached to the block, *b*, in the usual manner; *i* is the pin to which the connecting-rod is attached; on the block, *b*, are formed two grooves for the wedges, *w*, *w*, to work in; upon the outer surfaces of the wedges are fitted the surface-plates, *s*, *s*, in which plates are formed grooves similar to those in the block, *b*, which grooves maintain the wedges in their proper positions; at each end of the surface plates are projecting pieces or gibs, *g*, made to fit the block, *b*, for the purpose of preventing the surface-plates, *s*, *s*, from slipping off the wedges when in motion. *c* is a screw, firmly fixed to the block, *b*, upon which screw the nuts, *n*, *n*, are placed, for the purpose of giving motion to the wedges, when required, and also for keeping them in their true positions. It is evident that, on motion being given to the wedges in the direction of the block, *b*, the surface-plates will be proportionably expanded, so as to fill the space between the guide-bars, *f*, *f*, as the surface-plates wear away. The advantages of this expanding block are, that when the guide-bars are once fixed in their correct positions, they do not require, on the guide-block becoming slack by wear, to be in any way interfered with, but may, on being correctly fitted, be made fixtures, and allowed to remain in their original positions; the economy attending this block is, that when the surface-plates are worn away, they alone require replacing, and not the whole of the guide-block, as is usually the case.

Fig. 16 represents a side elevation of an improved arrangement or construction of a locomotive engine. *f* is the fire box, *b* the boiler, *s* the smoke-box; the steam cylinders, *c*, are attached to the outside of the usual framing, *i*, and placed between the wheels, *w w′*. The cylinders are placed at an angle with the horizontal line of the engine, and, through the intervention of the usual piston, piston-rod, *p*, and connecting-rod, *r*, give a rotary motion to the wheel, *w*, and the shaft, *s*, which driving-shaft is carried through the steam chamber and fire-box in the manner represented in fig. 4. The crank-pin, *o*, to which the connecting-rod is attached, is lengthened so as to allow the coupling-rod, *y*, to form a connection with it, and consequently impart a rotary motion to the shaft, *n*, through the crank, *t*, and from the crank, *t*, through the coupling-rod, *m*, to the wheel, *w′*, and consequently to the shaft, *d*, which coupled shaft passes through the smoke-box, *s*. The shaft, *n*, passes over the top of the boiler, (or, if required, it may be placed in a recess formed in the boiler.) and is connected with both engines. On the shaft, *n*, the eccentrics are placed for working the slide-valves.

* For this figure see the front page of last week's Number.

Mr. Johnson makes the following claims:

Firstly, I claim the different positions of placing the driving or coupled axles of locomotive engines, so long as the peculiar features of the arrangements before described are adhered to, and as exhibited in figs. 1, 2, 3, 4, and 5.

Secondly, I claim the employment or use of a chamber or chambers, situated between the tubes leading from the fire-box to the smoke-box, as also exhibited at fig. 5.

Thirdly, I claim the employment or use of a shaft, worked as described, for carrying eccentrics for working the slide-valves or pumps, or for giving motion to any other operative part connected with locomotive engines, as exhibited at fig. 6.

Fourthly, I claim the employment or use of an eccentric or eccentrics constructed with friction rollers, as described and exhibited at figs. 7 and 8.

Fifthly, I claim the employment or use of plates or valves, working underneath the usual slide-valve, for the purpose of working steam expansively, shutting it off, and for reversing the motion of the engines, which may either be accomplished as described and exhibited in figs. 9, 10, 11 and 12, or by any other suitable arrangement of the said plates or valves.

Sixthly, I claim the employment or use of an expanding slide or guide-block, as described and exhibited at figs. 13 and 14.

Seventhly, I claim the general arrangements of a locomotive engine, as described and exhibited in figs. 15 and 16, and also the mode of coupling four wheels, and the mode of coupling four wheels having outside cylinders placed between them, as exhibited particularly with reference to fig. 16.

And, *Lastly*, I claim the working of signals or whistles for engines, or guard, or other carriages, by means of exhausted air.

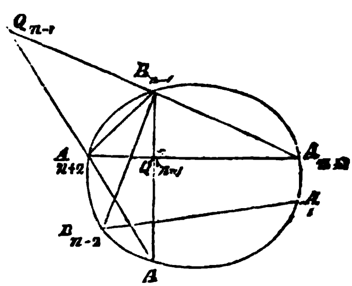
ON THE INSCRIPTION OF POLYGONS IN THE CONIC SECTIONS, THE SIDES OF WHICH PASS THROUGH GIVEN POINTS.

*By the Rev. Thomas Gaskin, M.A., late Fellow and Tutor of Jesus College, Cambridge. With Notes by Professor Davies, Royal Military Academy, F.R.S., L. and E.**

The first four propositions will be found useful in the succeeding investigation:

PROP. I.—*If* $2n-1$ *sides of a polygon of* $2n$ *sides inscribed in a conic section be parallel to* $2n-1$ *fixed lines, the remaining side will be parallel to a fixed line.* (Hutton's Course, 12th Edition, Vol. II., page 183.)

DEF.—Let Q_{n-1} be any point within or without a conic section, and let the polar to Q_{n-1} meet the diameter which passes through Q_{n-1} in the point Q'_{n-1}, then Q'_{n-1} is called the *principal pole* of the point Q_{n-1}.



PROP. II.—*Let* $Q_{n-1}\,B_{n-1}\,A_{n+1}$ *be any line passing through* Q_{n-1}, *and* $B_{n-1}\,A_{n+2}$ *an ordinate to the diameter through* Q_{n-1}, *then* $A_{n+1}\,A_{n+2}$ *will pass through* Q'_{n-1}, *the principal pole of the point* Q_{n-1}.

For, if $Q_{n-1}\,A_{n+2}$ meet the conic section in A, AA_{n+1}, $B_{n-1}\,A_{n+2}$ will meet in

* For a very detailed account of the labours of different geometers on the same problem, see a series of papers now publishing by Professor Davies in the *Mathematician*.

To prevent misapprehension, it is necessary to state, that the paper now printed is not that originally transmitted to us by Mr. Gaskin in December last, but a modification of it, sent to us subsequently through the friend who has added the notes.—ED. M. M.

the conjugate polar to Q_{n-1}; but $B_{n-1}A_{n+2}$ is parallel to that line, hence AA_{n+1} is parallel to the same line, and is, therefore, an ordinate to the conic section.

Now, the diameter through Q_{n-1} bisects the two parallel lines $A_{n+2}B_{n-1}$, AA_{n+1}, $\therefore AB_{n-1}$, $A_{n+1}A_{n+2}$ meet in that diameter; but AB_{n-1}, $A_{n+1}A_{n+2}$ meet in the polar to the point Q_{n-1}; hence they both pass through the point Q'_{n-1}.

Prop. III.—*If* $A_1 B_{n-2}$, $B_{n-2}B_{n-1}$ *be two chords of a conic section parallel to two given lines, and* $B_{n-1}A_{n+2}$ *be an ordinate to the diameter which passes through a fixed point,* Q_{n-1}; *then* $B_{n-1}A_{n+2}$ *is parallel to a given line, and* $A_1 A_{n+2}$ *will be parallel to a fixed line (by Prop.* I.)

Cor.—If $Q_{n-1}B_{n-1}$ meet the conic section in A_{n+1}, $A_{n+1}A_{n+2}$ will pass through Q'_{n-1}, the principal pole of the point Q_{n-1}. (Prop. II.)

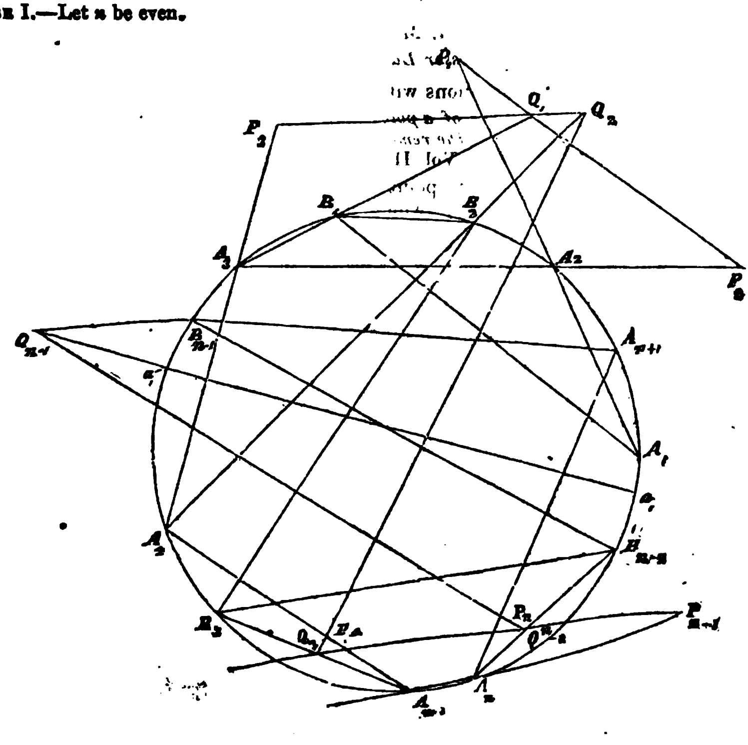
Prop. IV.—*Conversely; let* $A_1 B_{n-2}$, $B_{n-2}B_{n-1}$ *be parallel to two fixed lines, and let* $Q_{n-1}B_{n-1}A_{n+1}$ *be drawn through a fixed point* Q_{n-1}; *then, if* $A_{n+1}A_{n+2}$ *be also drawn through* Q'_{n-1} *the principal pole of* Q_{n-1}, $A_1 A_{n+2}$ *will be parallel to a fixed line.*

Cor.—If A_1 and A_{n+1} coincide, $A_1 A_{n+2}$ will coincide with $A_{n+1}A_{n+2}$; hence in this case $A_1 A_{n+2}$ becomes a straight line, passing through Q'_{n-1}, and parallel to a fixed line.

These four propositions are perfectly general; or equally true for all the conic sections, and for all positions of the points and lines concerned in the enunciations.

Prop. V.—*Let the* n *sides* $a_1 a_2$, $a_2 a_3 \ldots a_{n-1} a_n$, $a_n a_1$ *of a polygon* $a_1 a_2 \ldots a_n$ *inscribed in a conic section, pass through the* n *fixed points* $P_1, P_2 \ldots P_n$ *respectively; then a fixed point may be found such that the straight line joining that fixed point with* a_1 *(the first angular point of the polygon) may be parallel to a fixed line.*

Case I.—Let n be even.



In the conic section take any point A_1; draw $A_1 P_1$ meeting the curve in A_2; draw $A_2 P_2$ meeting the curve in A_3. . . . draw $A_{n-1} P_{n-1}$ meeting the curve in A_n; draw $A_n P_n$ meeting the curve in A_{n+1}; join $P_1 P_2$; draw $A_1 B_1$ parallel to $P_1 P_2$; join $A_3 B_1$ meeting $P_1 P_2$ in Q_1; then the chords $A_3 B_1$, $B_1 A_1$, $A_1 A_2$, $A_2 A_3$ meet the line $P_1 P_2$, at distances $P_2 Q_1$, ∞, $P_2 P_1$, O from P_2. Wherefore, (Geometrical Problems, App. II., Art. 50, Sect. 3,) $P_2 P_1 \times P_2 Q_1$ is constant for all positions of A_1; hence Q_1 is a fixed point.*

Join $P_3 Q_1$; draw $B_1 B_2$ parallel to $P_3 Q_1$; join $A_4 B_2$ meeting $P_3 Q_1$ in Q_2; then the chords $A_4 B_2$, $B_2 B_1$, $B_1 A_3$, $A_3 A_4$, meet the line $P_3 Q_2$ at distances $P_3 Q_2$, ∞, $P_3 Q_1$, O from P_3; and hence $P_3 Q_1 \times P_3 Q_2$ is constant for all positions of A_3, and, consequently, for all positions of A_1. Wherefore, again, Q_2 is a fixed point.

Join $P_4 Q_2$; draw $B_2 B_3$ parallel to $P_4 Q_2$; join $A_{n-1} B_3$, meeting $P_4 Q_2$ in Q_3; then the chords $A_{n-1} B_3$, $B_3 B_2$, $B_2 A_4$, $A_4 A_{n-1}$ meet $P_4 Q_3$ at distances $P_4 Q_3$, ∞, $P_4 Q_2$, O from P_4; whence $P_4 Q_2 \times P_4 Q_3$ is constant for all positions of A_1; and Q_3 is a fixed point.

Join $P_{n-1} Q_3$; draw $B_3 B_{n-2}$ parallel to $P_{n-1} Q_3$; join $A_n B_{n-2}$ meeting $P_{n-1} Q_3$ in Q_{n-2}; then Q_{n-2} is a fixed point.

Join $P_n Q_{n-2}$; draw $B_{n-2} B_{n-1}$ parallel to $P_n Q_{n-2}$; join $A_{n+1} B_{n-1}$ meeting $P_n Q_{n-2}$ in Q_{n-1}; then Q_{n-1} is a fixed point.

Now $A_1 B_1$, $B_1 B_2$, $B_2 B_3$ . . . $B_{n-2} B_{n-1}$ have been drawn parallel to the $n-1$ fixed lines, $P_1 Q_1$, $Q_1 Q_2$ . . . $Q_{n-2} Q_{n-1}$; hence $B_{n-1} A_1$ will be parallel to a fixed line for every position of A_1 (when n is even, Prop. I), and when A_1 is properly assumed, A_1 and A_{n+1} will both coincide with a_1, the first angular point of the polygon, and $B_{n-1} A_1$ will in that case coincide with $Q_{n-1} a_1$; hence $Q_{n-1} a_1$ is parallel to a fixed straight line, the direction of which may be determined by joining any two corresponding positions of A_1 and B_{n-1}.

Case II.—Let n be odd.

The same construction being made, in this case $B_{n-2} A_1$ will be parallel to a fixed line for every position of A_1 (Prop. I); but $B_{n-2} B_{n-1}$ is also parallel to a fixed line, and Q_{n-1} is a fixed point. Hence, if $A_{n+1} A_{n+2}$ be drawn through Q'_{n-1} (the principal pole of Q_{n-1},) $A_1 A_{n+2}$ will be parallel to a fixed straight line for every position of A_1 (Prop. IV.); and if the point A_1 be properly assumed, A_1 and A_{n+1} will coincide in the point a_1, which is the first angular point of the polygon, and $A_1 A_{n+2}$ will in that case coincide with $Q'_{n-1} a_1$ (Cor. Prop. IV.); hence $Q'_{n-1} a_1$ is parallel to a fixed line, the direction of which may be determined by joining any two corresponding positions of A_1 and A_{n+2}.

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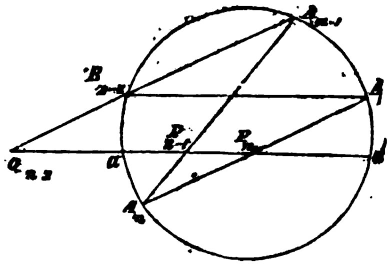
* This important extension of a theorem to the conic sections in general, which had been previously known to be true in the circle, will form an era in the history of this problem. I learn from Mr. Gaskin that he was led to it from considering the problem in respect to the circle, as it had been discussed by Mr. Swale in his "Liverpool Apollonius;" and I had myself been led to a corresponding result from the same paper about the same time. Mr. Gaskin's reasoning is, however, not only different from mine, but more compact and elegant than I think mine could possibly be rendered; and hence I am glad that he has been induced to publish his. The object that I had in view was, to obtain a demonstration on *geometrical principles* of the remarkable construction of Poncelet, or to find some other construction which should possess the same simplicity and directness. This, it will be seen, Mr. Gaskin has successfully effected.

I am certain that Mr. Swale's knowledge of the problem, and of its history, was derived solely from the brief and imperfect notice of it in "Bonnycastle's Geometry;" yet, the essential principle of Swale's analysis had been several times anticipated. In the case of the triangle, it was solved by Simson, in 1730 (*Traill's Life of Simson*, page 97); and this was reproduced by Fuss, in 1780 (*Petersb. Acta*, 1780); and, finally, it was extended by Ottajano and Malfatti to all polygons whatever inscribed in a circle. (*Memoria della Societa Italiana*, toma iv.) None of these authors, however, except Simson, give the *composition* of the problem. It must be remarked, that in the figure the lines Q_{n-2}, P_{n-1}, and $A_{n-1} A_n$, are not actually produced to meet, on account of the distance of their point of intersection not falling conveniently within the limits of the page. It is very difficult to design complex figures so that all the points concerned in the investigation shall fall within a limited space. It is a case of perpetual occurrence in transversal diagrams and in those of descriptive geometry; and in none more frequently than in those relating to this problem and its conjugate one referred to further on. For any imperfection in these diagrams I am alone to blame—not Mr. Gaskin.—T. S. D.

PROP. VI.—*In a given conic section to inscribe a polygon whose n sides shall pass through n fixed points* $P_1, P_2 \ldots P_n$.

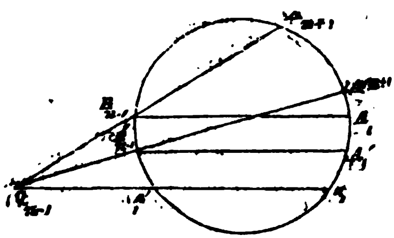


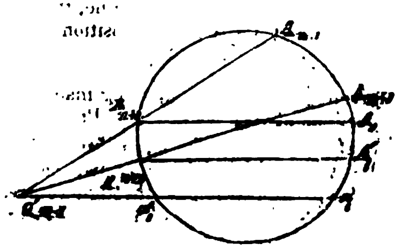
CASE I.—Let n be even.

In the conic section take any point A_1, and find $A_1, A_2 \ldots A_{n+1}$; $B_1, B_2 \ldots B_{n-1}$; $Q_1, Q_2 \ldots Q_{n-1}$, (as in Case I., Prop. VI.); through Q_{n-1} draw $Q_{n-1}\,a'_1\,a_1$ parallel to $B_{n-1}\,A_1$, meeting the conic section in a_1, a'_1, either of which will give the first angular point. Through P_1 draw $a_1\,a_2$; through P_2 draw $a_2\,a_3 \ldots$ through P_{n-1} draw $a_{n-1}\,a_n$; then $a_n\,a_1$ will pass through P_n.

CASE II.—Let n be odd.

In the conic section take any point A_1; find, as before, $A_{n+1}, B_{n-1}, Q_{n-1}$; and let Q'_{n-1} be the principal pole of Q_{n-1}; draw $A_{n+1}\,Q'_{n-1}\,A_{n+2}$; join $A_{n+2}\,A_1$; through Q'_{n-1} draw $a_1\,Q'_{n-1}\,a'_1$ parallel to $A_{n+2}\,A_1$, meeting the conic section in the points a_1, a'_1, either of which will be the first angular point of the polygon.





COR. I.—Let A'_1, A'_{n+1} be two other corresponding positions of A_1 and A_{n+1}, then when n is even, if $Q_{n-1}\,B_{n-1}\,A_{n+1}$, $Q_{n-1}\,B'_{n-1}\,A'_{n+1}$ be drawn, $B_{n-1}\,A_1$, $B'_{n-1}\,A'_1$ will be parallel to a fixed line $Q_{n-1}\,a'_1\,a_1$. If we take the six chords, $A_1\,A'_{n+1}$, $A'_{n+1}\,B'_{n-1}$, $B'_{n-1}\,A'_1$, $A'_1\,A_{n+1}$, $A_{n+1}\,B_{n-1}$, $B_{n-1}\,A_1$, then by the property of Pascal's hexagram, $A_1\,A'_{n+1}$ and $A'_1\,A_{n+1}$ will meet in the line $Q_{n-1}\,a'_1\,a_1$; and the same proof equally applies to the second figure when n is even.

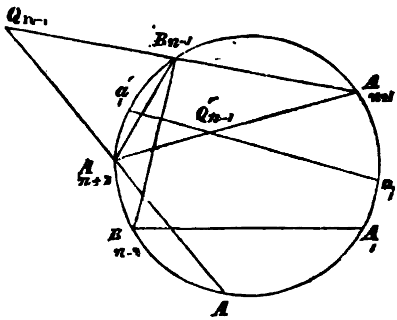
COR. II.—Hence, in all cases, let $A_1\,A_{n+1}$, $A'_1\,A'_{n+1}$, $A''_1\,A''_{n+1}$, be three positions of the chord $A_1\,A_{n+1}$; let also $A_1\,A'_{n+1}$, $A'_1\,A_{n+1}$ meet in b', and $A_1\,A''_{n+1}$, $A''_1\,A_{n+1}$ meet in b''; then b' and b'' will both be points in the line $a_1\,a'_1$; and the line joining b' and b'' will meet the conic section in the points a_1, a'_1, which will be the two positions of the first angular point of the polygon.*

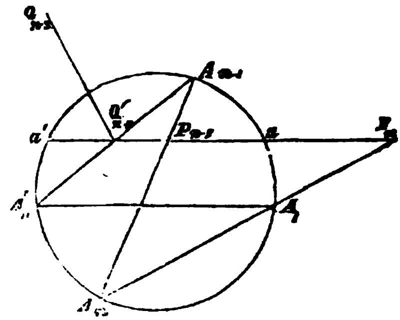
* Thus is obtained, as a mere corollary, the theorem upon which Poncelet's construction is founded. It is but right to state, however, that Poncelet only gives this construction incidentally, and for the illustration of his principle of projections; and that he gives several other theorems which are of high interest, and not easy to demonstrate on other principles than those which he employs. It is not improbable, however, that the method pursued by Mr. Gaskin may be competent to reach many of them, if not the whole; and they are well worthy of his attention. I will venture thus publicly (as I have done privately) to commend them to his notice; for I do not know an English geometer who is more competent to deal with them.

Apart from the fine conception of the principle, and the extraordinary results obtained by means of it by Poncelet, the circumstances under which it was developed are of the most touching interest. Poncelet,

If $a_1\, a'_1$ falls without the conic section, it will be impossible to inscribe a polygon whose sides shall pass through the given points.

Prop. VII.—*If $n-2$ sides taken in order of a polygon of n sides inscribed in a conic section pass through $n-2$ fixed points $P_1, P_2 \ldots P_{n-2}$, to find the position of two points P_{n-1}, P_n through which the two remaining sides must pass, in order that the first angular point of the polygon may be indeterminate.*





Case I.—Let n be even.

In the conic section take any point A_1; through P_1 draw $A_1\, A_2$; through P_2 draw $A_2\, A_3$.... and through P_{n-2} draw $A_{n-2}\, A_{n-1}$; find also the fixed points Q_1, Q_2....Q_{n-3} (as in Prop. VI.); draw $Q_{n-3}\, B_{n-3}\, A_{n-1}$, and join $B_{n-3}\, A_1$; then $B_{n-3}\, A_1$ is always parallel to a fixed line (Prop. VI., Case I.); draw $Q_{n-3}\, a\, a'$ parallel to $B_{n-3}\, A_1$, which will therefore be a fixed line; through any point P_{n-1} in this line draw $A_{n-1}\, P_{n-1}\, A_n$, and let $A_n\, A_1$ meet $Q_{n-3}\, P_{n-1}$ in P_n; then $A_{n-1}\, B_{n-3}$, $B_{n-3}\, A_1$, $A_1\, A_n$, A_n, A_{n-1} meet $Q_{n-3}\, P_{n-1}\, P_n$ at distances $P_{n-1}\, Q_{n-3}$, ∞, $P_{n-1}\, P_n$, O from P_{n-1}; ∴ $P_{n-1}\, Q_{n-3} \times P_{n-1}\, P_n$ is constant, and if P_{n-1} be a given point, P_n will also be a fixed point, and $A_n\, A_1$ will pass through P_n in all portions of A_1.

Hence, if P_{n-1} be any point in the line passing through Q_{n-3}, drawn parallel to $B_{n-3}\, A_1$, which joins any two corresponding positions of A_1 and B_{n-3}, the side $A_n\, A_1$ will always pass through a corresponding point, P_n, in the same straight line, such that $P_{n-1}\, Q_{n-3} \times P_{n-1}\, P_n = P_{n-1}a \times P_{n-1}a'$. (Geometrical Problems, App. II., Art. 50.)

Case II.—Let n be odd.

Take as before any point A_1 in the conic section, and find the points A_{n-1}, B_{n-3}, Q_{n-3}; let Q'_{n-3} be the principal pole of Q_{n-3}; draw $A_{n-1}\, Q'_{n-3}\, A'_n$; join $A'_n\, A_1$ which will always be parallel to a fixed straight line (Prop. VI., Case II.); through Q'_{n-3} draw $a'\, Q'_{n-3}\, a$ parallel to $A'_n\, A_1$ which will therefore be a fixed straight line; in this take any point P_{n-1}; draw $A_{n-1}\, P_{n-1}\, A_n$, and draw $A_n\, A_1$ meeting $Q'_{n-3}\, P_{n-1}$ in P_n; then $A_{n-1}\, A'_n$, $A'_n\, A_1$, $A_1\, A_n$, $A_n\, A_{n-1}$ meet $Q'_{n-3}\, P_n$ at distances $P_{n-1}\, Q'_{n-3}$, ∞, $P_{n-1}\, P_n$, O from P_{n-1}; ∴ $P_{n-1}\, Q'_{n-3} \times P_{n-1}\, P_n$ is constant for all positions of A_1; hence P_n is a fixed point; and wherever A_1 be taken, $A_n\, A_1$ will pass through P_n; and for any given position of P_{n-1}

a young engineer officer, was taken prisoner during the disastrous campaign of Napoleon in Russia, in 1813. With others, he was confined in the celebrated prison of Saratoff, deprived of books, pens, ink, paper, and everything calculated to render life endurable, and, as he expresses it, "Sur-tout distrait par les malheurs de ma patrie et les mieus propres." Yet even here his cultivated mind found resources: and the *Traité des Propriétés Projectives des Figures*, the fruit of his self-sustained heroism of mind, owes its existence to the severe misfortunes of its author. Poncelet is, however, better known in this country to intelligent engineers by his experiments and investigations relating to *industrial mechanics*, than by his researches in pure mathematics, valuable and curious as these last are. Practical men owe much to the mathematicians of the industrial school of Metz. It appears, from the newspapers, that Poncelet has been appointed Professor of Mechanics in the College of France, in conjunction with (amongst others) four members of the Provisional Government.—T. S. D.

in the straight line $Q'_{n-3} P_{n-1}$ drawn parallel to $A'_n A_1$, a corresponding position of P_n may be determined, such that $P_{n-1} Q'_{n-3} \times P_{n-1} P_n = P_{n-1} a \times P_{n-1} a'$.*

COR.—The straight line in which P_{n-1} and P_n lie, is manifestly that joining the two positions of the first angular point of the inscribed polygon, whose sides pass through the given points P_1, P_2 .... P_{n-2}.

Cambridge, March 24, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 343.)

V. *The Gentleman's Mathematical Companion.*

QUESTIONS. The total number of questions proposed and answered in this extensive periodical is 886. They are divided into two series; of which the first series contains 150 questions, and the second 736.

Classification of the first series of questions:

I. *Algebra.*—Ques. 3, 30, 51, 84, 127.

II. *Application of Algebra to Geometry and Mensuration.*—Ques. 1, 5, 15, 16, 27, 36, 56, 80, 81, 102, 117.

III. *Diophantine Analysis.*—Ques. 7, 10, 104, 107, 140, 141.

IV. *Geometry, Geometrical Analysis, and Construction.*—Ques. 2, 8, 9, 11, 12, 16, 18, 19, 20, 21, 22, 23, 24, 33, 38, 39, 40, 41, 42, 43, 44, 44*, 45, 47, 50, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 75, 76, 79, 83, 85, 86, 87, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 103, 105, 106, 109, 110, 111, 112, 113, 114, 115, 116, 119, 121, 122, 123, 124, 126, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 142, 144, 145, 146, 147, 150.

V. *Trigonometry, Plane and Spherical.*—Ques. 14, 17, 31, 32, 37, 53, 54, 59, 143.

VI. *Loci.*—Ques. 139, 148.

VII. *Fluxions.*—Ques. 52, 58, 77, 78, 82, 106, 108, 118, 120.

VIII. *Mechanics, including Statics and Dynamics.*—Ques. 29, 46, 48, 49, 55, 73, 74, 88, 101, 116, 125, 149.

IX. *Hydrostatics, &c.*—Ques. 6, 13, 25, 26, 28, 34, 35.

⁎ The 26th question of this series is the well-known one respecting the exciseman's staff: viz., "An exciseman's staff in the form of a cylinder, three-quarters of an inch in diameter and 36 ins. long, being immersed in a vessel of beer at one end, the other resting on the edge of the vessel 3 ins. above the liquor, I observed 13 ins. along the axis of the staff to be dry:—required the weight of the staff, a cubic inch of beer weighing ·5949 oz. avoirdupois?" It was first proposed by Mr. John Fletcher, of Liverpool, an able contributor to the periodicals of his time, as Ques. 609 in the *Gentleman's Diary* for 1789, and was solved in the following year by Messrs. Taylor, Mason, Youle, and Dalton, on the supposition that the fluid supported the *whole weight* of the staff. To their solutions a note is appended, endeavouring to prove the correctness of the above supposition; but this not appearing satisfactory to some mathematicians, Mr. James Wolfenden, of Hollingwood, near Manchester, drew up a correct solution in the year 1792, and forwarded it to the editor of the *Diary*, who, however, did not appear to be convinced by Mr. Wolfenden's reasoning, and his solution was not published. In 1798 Mr. John Farey, of Woburn, Bedfordshire, proposed a similar question (No. 753) in the *Diary*, which was solved in the following number by "Eumenes" (*query* the editor, the Rev. C. Wildbore?) who again fails in the attempt to deduce a verification of the solution to question 609. He, however, states in his closing remark, that "about one-quarter of the

* Intimately connected with this class of problems is another, the cardinal one of which is this:—*about a given conic section to circumscribe a polygon, whose n angular points shall be situated on n given lines.* The solution of the one leads immediately to that of the other; for the inscribed polygon whose sides pass through the *poles* of the given lines (viewed as polars) will have its angular points situated at the points of contact of the sides of the required polygon with the conic section. This is a species of reciprocity which we perpetually observe in respect to the conic sections; and which is, in fact, universal. This is admirably shown in the celebrated dissertation on Duality and Homography of M. Chasles, in the Brussels *Mémoires*. It is worthy of remark, too, that the doctrine of *poles and polars*, both as a system and in respect to the very terms employed, had its origin in the researches for a solution of the problem, which Mr. Gaskin has here so ably discussed. The first term is due to Servois and the second to Gergonne. See *Ann. des Math.* tom. i.—T. S. D.

weight of the staff will be supported by the side of the vessel." In 1798 the question was re-proposed in the *Companion*, and was correctly solved in the following year by Messrs. Edwards, Wolfenden, Bulman, and Surtees. Mr. Wolfenden's solution is very complete, so far as the question is concerned, and affords an excellent specimen of mathematical criticism. A varied form of the question was again proposed, as No. 808, in the *Diary* for 1801; and in his solution, in the next number, "Eumenes" again attempts to corroborate the results of Nos. 609 and 753; he, however, adds a correction of the latter part of this solution, on page 2 of the *Diary* for 1803. Mr. Fletcher's question was also proposed, as No. 16, vol. I. *Leybourn's Repository*, old series, but nothing more was given than a reference to the *Gentleman's Diary* for 1790, until Mr. Farey again took up the subject in article 17, page 160, vol. III. of the same work, and, both by investigation and experiment, confirmed the general correctness of Mr. Wolfenden's results. Some curious circumstances were observed during the experiment, to which Mr. Farey directed the attention of mathematicians; and in article 7, page 25, vol. I. of the new series of *Leybourn's Repository*, the subject is discussed at considerable length by "*Jac. Rube*," who considers the question under a great variety of forms, and fully explains the difficulties noticed by Mr. Farey. T. W.

Burnley, Lancashire, April 17, 1848.

Addenda.—"L. R.," who is mentioned in Article X., p. 342, was Mr. Michael Fryer, of London, editor of *Simpson's Geometry*, &c. See *Davies's Solutions to Hutton's Mathematics*, p. 510.

APPENDIX TO FIRST REPORT ON THE COALS SUITED TO THE STEAM NAVY. BY SIR HENRY DE LA BECHE AND DR. LYON PLAYFAIR.

Section I.—This consists of a description of the boiler and apparatus employed by Professor Wilson and Mr. Phillips to test the evaporating power of the coals.

The mode of operation adopted was as follows:

For drawing samples of the gases, the products of the combustion of the coals, a simple arrangement was adopted. A series of glass tubes, narrowed at each end, were connected together by caoutchouc tubes, and introduced into the iron tube of the chimney. The other end of the system of tubes was connected with a gas-holder filled with water. On opening the stop-cock of the gas-holder, connection was established between the chimney and the former, and a current of the chimney gases flowed through the tubes. After this had continued for some minutes, so as to expel the air, the caoutchouc joints were tied and the tubes removed. Their contracted parts were afterwards sealed by a blow-pipe's flame, and laid aside for analysis.

The method adopted for analysing the products of combustion belongs more particularly to the chemical part of the investigation, and will not, therefore, be described in this place.

The dew-point was taken at about the middle of each day's experiment, by means of a Daniell's dew-point hygrometer. The situation chosen for the observation was at the end of the boiler-house, farthest removed from the boiler, and the instrument was placed on a small wooden ledge, fixed against the wall at such a height as to bring the bulb of the instrument on a level with the observer's eye.

The two observations seldom gave a difference of 1°, in most cases much less.

Method of testing the cohesive power of the Coals.

For this purpose a wooden cylinder was employed 3 feet in diameter and about 4 feet long, each end having a bearing or gudgeon attached to it, on which the whole was made slowly to revolve. In the interior, three shelves tending to the axis were fixed, each being six inches in width: they were for the purpose of forming a lodgment for the coals, and of carrying them up towards the top of the cylinder during its revolution, thus insuring a certain amount of fall. An aperture was made at one end for the purpose of putting in the coals and for taking them out, which was closed, and rendered perfectly dust-tight by an oak door, firmly secured by an iron bar and staple. The cylinder was supported by a tressle at one end, the other gudgeon resting on a block let into the wall, and motion was communicated by a band passing round its circumference.

The coals to be tested were first broken to the size always employed in our experiments on their evaporating power, and then thrown on a sieve, the meshes of which were one inch square. Of the coals left on the sieve 100 lbs. were taken and put into the cylinder, which was then turned a certain number of times.

The whole was then allowed to rest a short time for the dust to settle, when the door was opened, and the coals again thrown on the same sieve, and the weight of coals remaining in it gave the per centage of large coals found in the Tables.

The values given in the Tables are the mean of two trials with each coal with 50 revolutions.

The box in which the coals were weighed for supplying the fire, and also to obtain the economic weight, was 2 feet long, 2 feet wide, and 1 foot 6 inches deep, and consequently contained six cubic feet. The large coals were reduced to pieces, not exceeding 1 lb. weight previous to weighing, and this was the maximum size employed throughout the experiments.

Method of conducting the Experiments.

Having described the boiler and apparatus connected with it, we have now to state the course pursued in conducting the experiments.

Let us suppose the water in the boiler to be cold, and to stand about 1 inch below the normal level. The fire was lighted, and any coals that might be conveniently employed to get up the steam in the afternoon of the day preceding the commencement of the experiments. As soon as this was the case, the fire was allowed to burn out, when the fire and ashpit doors, as well as the damper, were closed.

The next morning the first thing done was to open the safety-valve, to equalize the external and internal pressures, and then sufficient water was let down from the tanks to raise that in the boiler to the normal level.

The depth of the water in the tanks was then gauged, and the first observation of its temperature made. The ashes, cinders, and soot were next cleared out, and after noting the temperature of the water in the boiler, the fire was lighted with a weighed portion of wood, and the exact time was then observed.

The coals were then gradually added till the fire was of the proper size and form. The form of fire was slightly varied according to the kind of coal employed, our object being to burn the coal to the best advantage, with as little smoke appearing at the chimney top as possible.

The observations of the temperatures of the two side and escape flues, and of the water in the tanks, then succeeded each other at regular intervals of about an hour each.

When the steam raised the safety-valve, the time was observed and entered under the heading "Steam up." The damper was adjusted as soon as the fire was sufficiently established, and was not disturbed during the day, except under peculiar circumstances.

When by evaporation the water had sunk 1 inch below the normal level, the deficiency was supplied from the tanks above: this was the plan pursued at first, but latterly we found it more convenient to allow the water to flow in continuously, so as to maintain the water in the boiler at a constant level, which was easily accomplished after a little experience.

In the management of the fire, care was taken to supply the coals in pieces not exceeding 1 lb. in weight, and in quantities of not more than one or two shovelsful at a time, spread evenly on the fire, except in the cases of the anthracite and some of the bituminous coals. In the case of the anthracite, it was found that the sudden application of heat caused the pieces to split, and fall through the bars, and hence a gradual heating on the dead-plate was beneficial. With the bituminous coals a preparatory process of partial cooking on the dead-plate prevented them from caking in the fire, which would have impeded the passage of air through the grate, besides giving better opportunity for burning the smoke and gases, by passing them over a large surface of ignited fuel.

The duration of the experiment was reckoned from the time the steam was up to about that of the last application of fuel, after which the fire was allowed gradually to burn out, when the damper, and furnace, and ashpit doors were closed.

During the day the ashes were thrown up in small quantities from time to time when the fire was burning clear and well.

The weight of coals consumed was then ascertained, by deducting the weight left from the gross weight provided for the day's trial, and the experiment terminated.

The next morning, when the level of the water in the boiler was adjusted by turning down a supply from the tanks, their depth was gauged, and the quantity evaporated the previous day was thus ascertained. The ashes and cinders were then removed, the clinkers, if present, separated, and the weight of each taken. The soot was cleared out at the end of the last day's experiment, and the total weight recorded, which, divided by the number of trials, gave the average weight

Samples of the ashes, cinders, and soot were then put aside in bottles, for the purpose of ascertaining the per centage of combustible matter present in the residue.

The barometer was observed at about 11 o'clock in the day, being generally about two hours after the steam was up.

Method of estimating the quantity of Combustible Matter in the residue.

This consisted in heating the powdered

substance in a stream of oxygen gas, by which the organic matter was dissipated chiefly as carbonic acid and water, and estimating the loss as combustible matter.

For this purpose a piece of German glass tube, 4 ins. long, and half an inch in diameter, was drawn out at one end to a small orifice, which was then loosely obstructed by a piece of abestos. It was then weighed, and again after the introduction of a small quantity of the substance; after which it was attached to the cock of an ordinary gas-holder filled with oxygen, by means of a piece of glass tube and a cork.

A lamp was next placed under the tube, and the powder in it gradually heated up to incipient redness; when this was the case, the cock was opened, and a slow current of oxygen was made to pass over the heated material. Combustion then commenced, and was continued till the organic matter was entirely consumed; the gases escaping at the extremity of the tube, and the asbestos at the same time preventing the possibility of any of the powder from being carried away mechanically by the current; the cock was then closed, and the tube allowed to cool. When cold it was weighed, and from the loss it was easy to calculate the per centage of combustible matter which is given in the Tables.

It was found advantageous not to reduce the ashes, &c., to a very fine powder, for when in that state the high temperature caused the fusion of some of the inorganic substances, which prevented the complete combustion of the organic matters, by defending them from the action of the stream of oxygen.

Great pains were also taken to obtain water of uniform temperature in boiler, but the method of doing so would not be readily understood without the help of the engravings.

Section II.—Report on the evaporating power of different sorts of coal. By Mr. J. A. Phillips. To this is added the following

COMPARISON *between the Effects produced by the* BOILERS *at* PAR CONSOLS MINE, *and those obtained from that employed for the purposes of the foregoing Investigation.*

A large amount of facts relative to the evaporative powers of various coals having been amassed during the progress of this inquiry, it was thought desirable to ascertain how nearly these results approach the maximum duty obtained from Cornish boilers, and thus furnish a means of comparison between the apparatus employed for the purposes of this investigation, and larger boilers, of similar construction, as used for practical purpose.

Experiments have at different times been made, in order to ascertain with accuracy the quantity of water which can, under the most favourable circumstances, be evaporated from a given temperature, by the combustion of 1 lb. of coal.

No very decisive results appear, however, to have been arrived at; as, on consulting those of the different experimentalists, considerable differences will be observed. Smeaton, who seems to have been the first to pay serious attention to this subject, found, in the year 1772, that 1 lb. of Newcastle coal evaporated 7·38 lbs. of water from 212°. Watt, who turned his attention to this subject in the year 1788, arrived at the conclusion that 8·62 lbs. of water might be evaporated from the temperature of 212° by 1 lb. of the coal employed in his experiments; whilst Mr. Wicksteed, in the year 1840, found that 1 lb. of Merthyr coal could be made to evaporate 9·493 lbs. of water from the temperature of 80° Fahr., which is equal to the evaporation of 10·746 lbs. from the temperature of 212°.

Some experiments were also made about this time on the boilers of Loam's engine, at the United Mines in Cornwall, to which was adapted an apparatus which correctly measured the quantity of water injected into the boilers. The experiment was continued six months; and during that time it was found that 234,210 cubic feet of water, at the temperature of 102° Fahr., had been pumped into the boiler, and that 700 tons of coals had been consumed in its evaporation; thus showing that 15 cubic feet of water, at 102°, had been evaporated for each 100 lbs. of coals used; or that each pound of coals consumed had evaporated 10·29 lbs. of water from the temperature of 212° Fahr.

It will be observed that these results not only differ considerably from each other, but also that no means was employed for the purpose of ascertaining the chemical composition of the various coals used, which should, we conceive, form an important part of all such investigations. In order, therefore, to obviate this inconvenience, as well as to take advantage of such improvements as may have been introduced since the dates of the foregoing experiments, it was determined to make a similar inquiry into the evaporating powers of the boilers of one of the best Cornish engines of the present day. That chosen for this purpose was the large pumping-engine at Par Consols Mine, where every facility was afforded by Mr. West, the engineer, for carrying on the experiments effectually. This engine is an 80, with a 12-foot stroke in the cylinder, and is worked

by two boilers,* to which is added an arrangement by which the feed-water is heated to near the boiling point before entering the boiler. This is effected by means of the waste heat escaping from the flues; and the apparatus consists of two wrought-iron tubes, each about 20 inches in diameter, placed above each other, and parallel to the axis of the boilers, in the brickwork of which they are inclosed. The feed-water is pumped into the upper tube by means of the usual arrangement, and then descends through a pipe into the lower one, from whence it passes into the boiler itself. Both these tubes are exposed in their whole length to the action of the heated gases coming from the fires, which, after having made the circuit of the boilers, pass round the warming tubes before arriving at the base of the chimney; the water in the tubes is thus heated to about 212° by means of the heat absorbed from the gases passing through the flues, and of which the temperature is reduced to about 300° by the time they arrive at the base of the chimney. Our experiments were conducted in the following manner:

It was first necessary to be enabled to measure with accuracy the quantity of water supplied to the boilers; and in order to effect this, a large cistern was placed near the air-pump, from the cistern of which it could, by a simple arrangement, be filled with water. The connecting-pipe between the feed-pump and air-pump cistern was then removed, and a pipe fitted to the feed-pump, which reached the bottom of the reservoir. The cistern was also provided with a waste-pipe, which prevented its being filled beyond a certain point; it was then filled with water and pumped out, in order to ascertain at what level the pump ceased to act. This point being decided, water was weighed into the cistern until it reached the level of the waste-pipe before mentioned, when it was found to contain 1260 lbs. It was also necessary to be enabled to stop the action of the feed-pump during the filling up of the cistern; and this was accomplished by means of a stop-cock placed in the feed-pump immediately under the stuffing-box, which, when opened, let in air and prevented the formation of a vacuum.

The measurement of the injected water was thus rendered excessively easy, as it was only necessary to count the cisterns pumped into the boilers, and open the stop-cock whilst it was being filled, in order to do so with accuracy.

The arrangements for measuring the water having been completed, the experiment was begun; and at the expiration of 46½ hours it was found that 95 cisterns of water* had passed into the boiler, and that 11·730 lbs. of coals had been consumed; or, in other words, that 11·730 lbs. of coals had been consumed in order to evaporate 119,700 lbs. of water from the temperature of 92° Fahr., which gives 10·204 lbs. of water evaporated from that temparature for every pound of coal consumed. If, as in the former part of this Report, we take 212° as the standard temperature, we find that each pound of coal employed had evaporated 11,428 lbs. of water from the boiling point.

The combustible employed during this experiment consisted of a mixture of Swansea and Bury coal; but in what proportion, or from what pits, we were unable to learn. An analysis of the mixture was, however, made by my colleague, Mr. H. How, who obtained the following results:

Carbon	84·19
Hydrogen	4·19
Oxygen	0 86
Nitrogen........	0·80
Ash	8·06
Sulphur	1·90
Total	100·0

These coals were also found to contain 6 per cent. of water, the greater portion of which had been intentionally added, for the purpose of communicating intensity to the heat obtained during their combustion.

Having now ascertained the quantity of water evaporated by 1 lb. of coals, as well as the composition of the coal employed, it remains to institute a comparison between the evaporative capacity of the boilers experimented on, and that employed for the purposes of this inquiry. In order to have done this, it would have been desirable to have made a comparative experiment with the same coal when consumed in the latter boiler; but as circumstances prevented this from being done, we may obtain nearly the same results by consulting the Table of Analyses, and selecting a coal having as nearly as possible the same composition as that in question.—(*To be concluded in our next.*)

THE ROYAL POLYTECHNIC INSTITUTION.

After having been closed for two or three months, for the purpose of renovation and enlargement, this admirable Institution is now on the eve of being re-opened. An entirely new lecture-room has been built, capable of holding upwards of 1,200 persons; several new galleries have also been added, and various other additions and alterations made, eminently calculated to increase the attractiveness and utility of the Institution.

* The boilers on which this experiment was made are each 32 feet in length, and 6 feet 3 ins. in diameter. Each boiler presents a heating surface of 95? square feet, and the warming apparatus offers a surface of 560 square feet to the action of the heated gases.

* We took care to assure ourselves, by means of the gauges, that the boiler contained the same quantity of water at the beginning and close of the experiments.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Henry Henson Henson, of Hampstead, Middlesex, gentleman, for certain improvements in railway carriages and wagons, and in vessels of capacity employed in the storing and conveyance of explosive substances. April 15; six months.

Thomas Forsyth, of New North-road, Middlesex, engineer, for improvements in the manufacture of railway wheels. April 15; six months.

Charles Green and James Newman, manufacturers, of Birmingham, for improvements in the manufacture of a part or parts of railway wheels. April 15; six months.

Richard Madigan, of Haverstock Hill, Hampstead-road, Middlesex, civil engineer, and John Coope Haddan, of Lincoln's-inn Fields, Middlesex, civil engineer, for improvements in the manufacture of wheels for railways. April 15; six months.

Selah Hiler, of New York, in the United States of America, for improvements in the manufacture of stair-rods. April 15; six months.

David Davies, of Wigmore-street, Cavendish-square, coachmaker, for certain improvements in the construction of the heads of open and close carriages. April 15; six months.

Charles Attwood, of Wolsingham, Durham, Esq., for a certain improvement or improvements in the manufacture of iron. April 18; six months.

John Britten, of Birmingham, for certain improvements in heating, lighting, ventilating, and closing and securing the doors of apartments, also in lighting and ventilating carriages, parts of which improvements are applicable to other like purposes. April 20; six months.

Mathew Cochran, of High-street, Paisley, Renfrewshire, for certain improvements in the production of coloured patterns or designs on warps of carpets, velvets, and other textile materials, parts of which improvements are also applicable to the production of coloured patterns or designs on woven fabrics or other plane surfaces April 20; six months.

Samuel Clegg, of Regent's-square, Middlesex, engineer, for improvements in gas-meters. April 20; six months.

John Thang Harradine, of Holywell-cum-Needingworth, Huntingdonshire, farmer, for an improved mode of fitting certain girths and straps. April 20; six months.

Henry Gilbert, of St. Leonard's-on-Sea, Sussex, surgeon, for an improved mode or modes of operating in dental surgery, and improved apparatus or instruments to be used therein. April 20; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
April 14	1413	Richard Wallis, Jun....	Basingstoke	Machine for cutting turnips and other vegetables.
,,	1414	John Davis	Leadenhall-street, cutler	The Norman razor.
,,	1415	George Graham	Leeds	Washing, wringing, and mangling machine.
18	1416	Robert Marples	Sheffield	Brace pad.
19	1417	Samuel and Thomas Carsington	Stockport	Hat ventilator.
,,	1418	C. and W. Lancaster ...	New Bond-street	Rifle barrel.
,,	1419	Bryan Donkin and Co...	Grange-road, Bermondsey	Gas valve.

NOTICES TO CORRESPONDENTS.

The Supplement to the last volume (which, owing to an unfortunate accident to the manuscript, has been unusually delayed,) containing title, index, &c., will be published on the 1st of May.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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Edited by J. C. Robertson, 166, Fleet-street.

LLOYD'S PATENT IMPROVEMENTS IN THE PREPARATION AND MANUFACTURE OF TOBACCO.

Fig. 1.

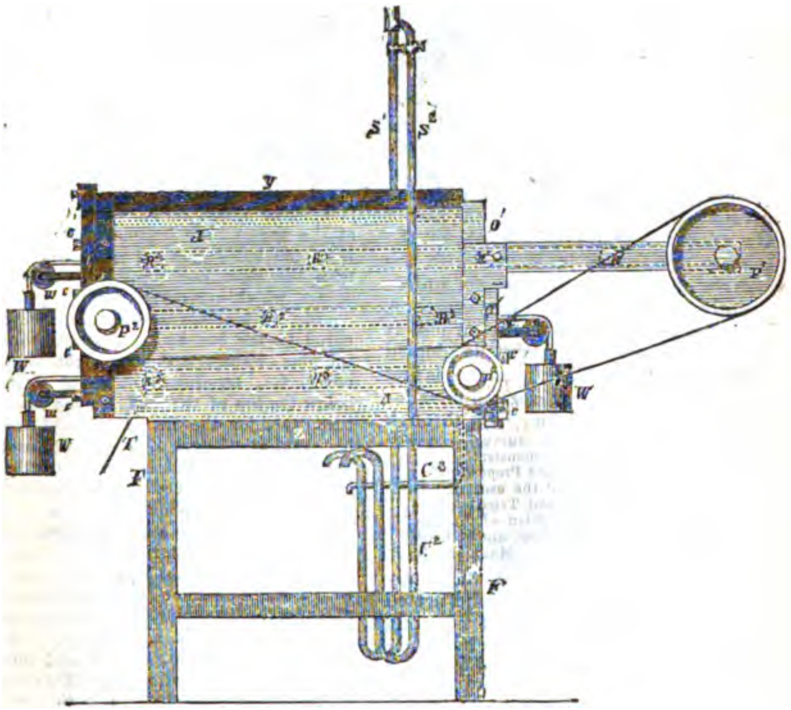


Fig. 2.

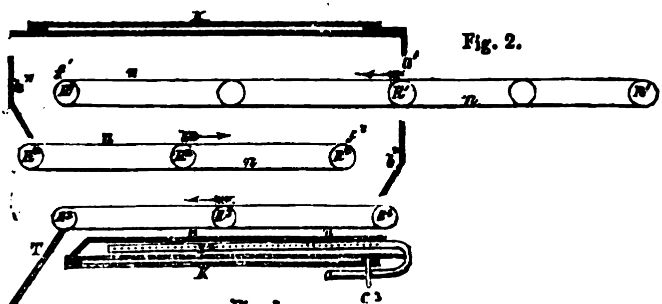
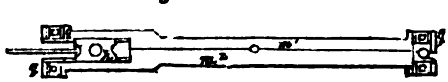


Fig. 3.



MR. LLOYD'S PATENT IMPROVEMENTS IN THE PREPARATION AND MANUFACTURE OF TOBACCO.

[Patent dated October 14, 1847; Specification enrolled, April 14, 1848.]

In the preparation and manufacture of the description of tobacco known by the name of "cut," or "shag" tobacco, the practice commonly followed in order to "open," or "get (it) out of cut," as it is technically termed, has been to place the tobacco, on coming from the cutting machine, on a heated plate of metal, on which plate the workman keeps turning and opening it out by hand, until it is supposed that an equal degree of heat is diffused throughout the mass, and the "getting out of cut" thoroughly effected; but, by this mode of operation, it unavoidably happens, even with the greatest care and attention on the part of the workman, that some portions of the tobacco are longer in contact with the hot metal than others, and not unfrequently overdried and even scorched, whereby the quality of the article is much impaired. Another mode adopted is the following:—The cut tobacco is first placed on a plate of perforated metal or wire gauze, covered with cloth, through which perforated metal or wire gauze and cloth covering, steam is made to ascend and mix with the tobacco, which is from time to time turned and partially opened out by hand as before; and when the tobacco is supposed to have been thus thoroughly and uniformly heated, it is transferred to a solid heated plate, on which the process of "getting out of cut" is completed also by hand; but this latter method, though superior to the former, has been found equally open to the objection of being uncertain and defective in its results, since it is at all times dependent on the attention and skill of the workman.

Now the improvement introduced by Mr. Lloyd—and it is manifestly one of great importance to the tobacco trade—consists in preparing cut or shag tobacco for the process of "opening out" or "getting out of cut," and also partially effecting that process by means of steam machinery, "whereby manual labour is entirely dispensed with (except in so far as it may be required for putting in motion or feeding and directing the machinery,) and the process is more uniformly, expeditiously and beneficially accomplished." Mr. Lloyd describes two machines by which this may be done; but we shall content ourselves with extracting his description of the one which seems to us the more likely (from its greater convenience) to come into general use:

Fig. 1, is a side elevation of the machine; fig. 2, a longitudinal section on the line, v, x; fig. 3, a transverse section on the line, y, z; and fig. 4, a left end view with the cover removed. A is an oblong box, which is mounted on a standard, F, and formed at top, bottom, and sides, of two plates (riveted together) placed at a little distance apart, so as to leave a continuous open, or jacket-like space, K, K, all round (except at the ends.) The bottom of the box, A, is at the left end, about 4 inches shorter than the sides and top. C^1, C^2, are end covers, which are made of single plates or boards, removeable at pleasure, being secured to the box by keys, passed through the pins or studs, c, c. The right-hand end cover, C^1, terminates at about 4 inches below the top of the box, leaving an aperture, O^1, for the introduction of the tobacco into the box. Z is a plate, or false bottom of zinc, which is carried a little way above the hollow bottom, K, and is narrower than it by about 1½ inches on each side, so as to leave a free passage on each side up into the interior of the box. S^1 and S^2 are two steam pipes communicating with a boiler or some other suitable source of supply. The pipe, S^1, leads into the jacket-like space, K, K, and supplies steam for warming the top, bottom and sides of the box, A. The other pipe, S^2, which is intended to convey steam into the interior of the box, passes outside of the box down to a level with the bottom (see fig. 4), then turns off at a right angle under the bottom till it reaches midway between the two sides, when it is bent up, carried round to one end of the hollow bottom, K, and then continued along from end to end of the box in the space between the hollow bottom, K, and the false bottom, Z. The last-mentioned portion of this pipe, namely, that between the two bottoms, is perforated at the sides with a number of small holes, to allow of the escape through them of the steam, which then spreads under the false-bottom, Z, and finds its way up the open spaces at the sides into the interior of the box. C^1 and C^2 are syphon tubes, which are respectively connected with the jacket-space, K, and steam-pipe, S^2, and serve to carry off any con-

Fig. 3.

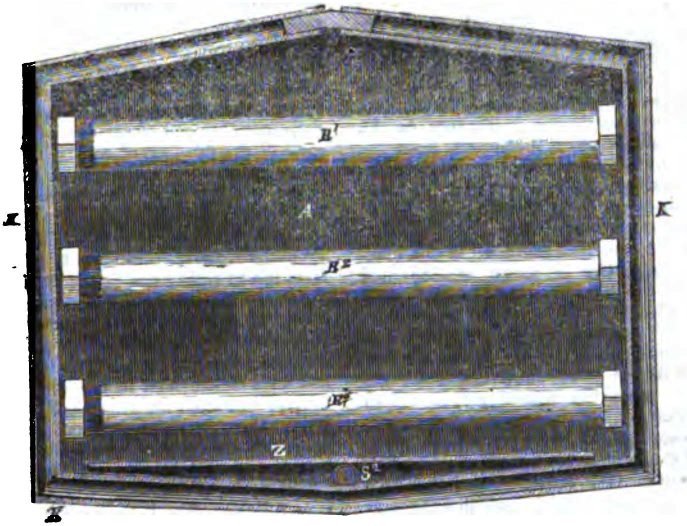
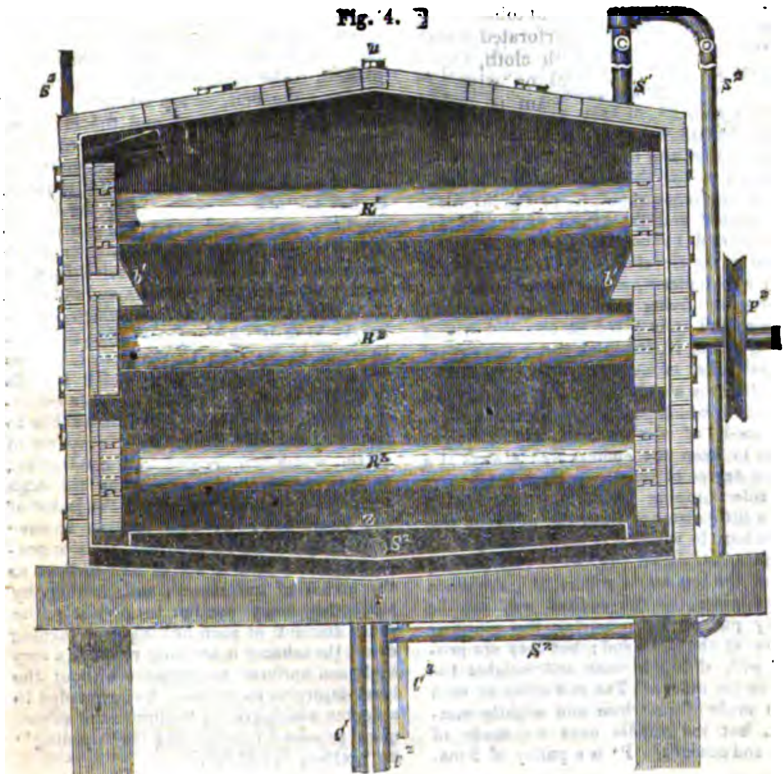


Fig. 4.



densed steam from those parts of the apparatus. C^3 is a waste pipe, which carries off the water of condensation from the interior of the box, that is to say, such water as collects on the top of the hollow bottom, which bottom is, for the sake of facilitating the escape of the water, slightly inclined on both sides towards the middle (see fig. 3), and has also a slight inclination from the left end to the right (where the water-pipe, C^3, is placed). S^3 is a vent pipe, to allow the air to escape from the jacket-space, K, when the steam is admitted. R^1, R^1, R^1, R^1 and R^1, are five rollers, all in one horizontal plane, two of which are mounted inside of the box, two outside of it, and one on a line with the right end of the box. R^2, R^2, R^2, are three other rollers, which are mounted within the box below the first set, and R^3, R^3, R^3, a third set, which are mounted below the second set, and also within the box. Each of these sets of rollers is encompassed by an endless web, *n*, *n*, (that of the first, or top set, passing through the opening, O^1, in the right end of the box,) and revolves with its web independently of the others; each web travelling in the direction indicated by the arrows annexed. The sets, moreover, are so placed in vertical relation to one another, that, supposing a layer of tobacco to be placed on the first web when it reaches the farther or delivery end, f^1, of that web, it drops on to the second web, and, when carried forward by that web to its delivery end, f^2, it drops on to the third web, which carries it to the discharge shoot, T, of the machine. The second and third sets of rollers are each carried by bearing bars of the form shown in the elevation, fig. 5. Each bar is made in two pieces, m^1, m^2, to allow of the endless web being put on the rollers with facility; and it is fitted at one end with a sliding brass, X, in which turns one end of the last roller of each set. To each sliding brass there is a weight, W, (fig. 1,) attached by a cord, which passes over a small pulley, *w*, outside of the box, A, which weight serves to keep the endless web always at a proper degree of tension. Each bar has on one side chipping pieces, *q*, *q*, which keep it at a little distance from the adjacent side of the box, to which it is made fast by bolts and nuts, as shown (fig. 4). The bearing bars of the top set of rollers, R^1, are made in one piece, as the endless web can be readily put on by removing the coupling brasses at the right end; but they are provided with sliding brasses and weights the same as the others. The end roller of each set is made of cast iron and slightly cambered, but the middle ones are made of brass, and straight. P^1 is a pulley of 9 ins. in diameter, which is attached to one end of the axis of the outermost of the first set of rollers, R^1; P^2 another pulley of 6 ins. diameter, which is attached to the same side of the axis of the innermost of the second set of rollers R^2; and P^3 a double pulley of 4½ ins. in diameter, which is fixed on the corresponding end of the axis of the outermost of the third set of rollers, R^3. These three pulleys are connected by bands, as shown (fig. 1), and being set in motion by any suitable prime mover, give motion to the rollers and endless webs. The pulleys, P^1 and P^3, move from right to left, but P^2 from left to right; and as the pulleys are of different diameters, the endless webs necessarily move at different rates of speed. Guides b^1 b^1, and b^2 b^2, are affixed in angular positions, as shown, to the sides and ends of the box, in order to guide the tobacco in its fall from one web to another. Below the end roller of the middle set there are two other guides, similar to b^1, but they are not shown in the engravings.

The mode of operating with the machine is as follows: The hollow space or jacket, K, is first filled with steam, by opening the steam-cock of the pipe, S^1, and then the steam-cock of S^2 is opened to admit steam into the interior of the box, as before explained. The endless webs are then set in motion; the first, or top set, at the rate of about 1 foot per minute, and the others at rates corresponding to the diameters of the pulleys, by which they are respectively moved. The "cut," or "shag" tobacco, is then taken as it comes from the cutting machine, and spread over that part of the first endless web which is outside of the box; and by that web it is carried forward to the opposite end of the box and delivered on to the second endless web, which, carrying it back in the opposite direction, delivers it in its turn to the lowest endless web, after travelling over which it falls down the shoot, T, into any suitable receiving vessel. By causing the tobacco thus to travel to and fro within an atmosphere of steam, which is prevented from condensing, to any considerable extent, by the high temperature maintained within the jacket of the steam-box; by also turning it over repeatedly during its progress, so as to present at each turn a set of new surfaces to the action of the steam; and, further, by subjecting every portion to precisely the same amount of such heating and turning over; the tobacco is not only raised to a very high and uniform temperature without the least injury to its texture, but expanded to a degree which greatly facilitates the subsequent process for completing the "opening" or "getting out of cut."

Mr. Lloyd states that this machine may be "applied with advantage to the steaming of leaf tobacco in the compressed state in which it is imported; the opening up and separation of the leaves preparatory to damping being thereby much facilitated." It requires also to be only slightly modified to be made suitable for the damping of leaf tobacco. "For this purpose, one, two, or more sets of rollers and endless webs may be mounted in a suitable framework, and each endless web surmounted by a pipe placed at right angles to the line of motion, and perforated with a number of minute holes, through which water (supplied from any convenient source) is made to trickle upon the tobacco as it passes underneath."

"SYLVA SYLVARUM NOVA."

Sir,—In reflecting upon the extreme activity of the human mind, the frequent misdirection of its labours, and the vast amount of intellect so fruitless in its toil, I have been forcibly struck with the pressing necessity which exists for economising this mental energy, and for applying its intensity in that mode which may be most remunerative to the world at large.

Though I shall lay before your readers some ideas obvious in pursuing such a train of thought, it is not without being sensible that they are neither distinctly arranged nor lucidly expressed; and, indeed, the inquiry is one which it will be difficult to confine within those paths of knowledge legitimately occupied by the *Mechanics' Magazine;* for it is replete with generalities, and apt to ramify into pure metaphysical discussion. Nevertheless, upon those who by such difficulties would be deterred from the attempt, I would urge the interest surrounding the subject, and the importance of the investigation to philosophy in general; nor can I consider anything as foreign to the objects of your journal which is wholly directed to the creation, increase, and diffusion of practical learning.

I shall start, then, with a grand question, the very vastness of which will be enough to show that I do not intend to treat it as undivided:—"How shall we best employ our intellectual powers?"

Leaving wholly unnoticed the lengthy catalogue which enumerates the objects of moral and political philosophy, of ethics, logics and mathematics, the fine arts, most of the mixed sciences, and by whatever names the investigations which relate to the final constitution of mind or matter are interlaced together, and narrowing our inquiry to the subject of natural philosophy; I think that, even thus limited, the field is a wide one to expatiate in, and one which, if explored, would richly repay examination.

To satisfy the inquiry as contained in the above question is utterly beyond the powers of man. Embracing merely the mixed sciences, I fear that there is but one man in Europe who could in a lifetime sketch the faintest outline of a reply. If we again exclude all branches of study but natural history, we shall find that the giant mind of Bacon recoiled from the task, and that, even when these words represented a science comparatively meagre and undeveloped, *he* strove in vain to seize it all in his capacious grasp.

It is, therefore, no wonderful sign of prudence or of modesty, if I shall still further isolate my subject, and confine my consideration to the more efficient application of the labour now thrown away in *experiment* in natural philosophy. By this term experiment, *instantia,* I would designate not only the researches directly carried on by manipulation, but in addition to those practical operations of the laboratory, every suggestion thrown out by one mind likely to promote activity in another, and that whether hinted in private communication, or widely published through the press.

However sad may be the truth, I think that few of those interested in philosophy will deny that an enormous amount of active ingenuity, by being misapplied, is wholly unproductive to the community.

In the onward march of knowledge, we find two descriptions of men utterly useless to the "grand army." One set have no ambition for progress—lag far behind the age, or come to a dead halt. Happily few can retrograde, for we cannot so easily unlearn learning. But it is not to these I wish to direct attention: they are simply an incumbrance to advancement, and, if their case be hopeless, I would have them left in the stationary condition of idleness which they have chosen.

The other class are less numerous, but more interesting—they possess great mental activity and zeal in the cause; some bear the impress of genius, many of them are gifted with talent, and nearly all pursue some object with undying ardour and with little success. They push on with energy, but it is in a wrong direction. Their labour is ceaseless, but it is misapplied. While others, less enthusiastic, march forward in a compact phalanx against ignorance, *they* rush frantically in all directions but the right one: heedless of sober counsel, each starts aside after some retreating fascination of his own, which is never destined to be grasped; and, alas! too many thus straggling from the ranks are cut off singly and at a distance, calling too late for the aid of those they have wilfully deserted.

But the truths thus clothed in simile lose no importance when unveiled. The delusions of the alchemists of the olden times—the elixirs and nostrums in later years, and the perpetual motions, self-moving engines, and countless chimeras of our own days—are but the glaring and manifest examples of the intellectual vigour thus recklessly wasted. Yet they bear but a small proportion in number to the visionary schemes daily leading thousands astray. Like wrecks on this side and on that of the straight course of knowledge, warning the watchful voyager, they are few when compared with the multitude of those who have foundered in deeper water, or who, rashly wandering from the true channel, have never been heard of more, and have not even had the consolation that their fate is a beacon to others.

Such hapless cases we find in all the departments of learning: theology, law and medicine, politics and mechanics alike. Wherever there exists "*terra incognita*," there you shall find men burning to explore it, but perversel entering by the most unusual routes, and quite unprepared for their journey.

But we are confined, for the present, to the material sciences.

Here is a poor mechanic—whose daily earnings scarcely meet the wants of those dependent on him, yet the monotony of his task is enlivened by a bright idea which has flashed across his mind. Certain at once of his conclusions, and that, without examining his premises, he sets himself to work upon this baseless project. No failures weary him, no difficulties seem unsurmountable—his last penny is spent upon it, and perhaps his life, and yet neither the man nor the world gains a single farthing! There, again, is a richer votary of some shadowy notion: his endeavours are expensive and innumerable—his exertions are not wholly unnoticed by others—he may possibly provoke discussion of his scheme in some journals of the day. Impatient of the criticisms of others, and smiling at their incredulity, *he* also ends, and the fruit again is—nothing!

However, let these remarks suffice, while asserting the wide-spread existence of this evil.

Unlike the case of many other acknowledged abuses I consider the hopes of the successful application of a remedy to be far from discouraging; for we may not with reason be faint-hearted, while contemplating the possibility of improving a state of things, when, as yet, no direct efforts have been made for such amelioration. But before discussing those remedies, I shall have to observe upon the cause of the disease, whether predisposing or immediate, and although I have not yet carried my subject even so far as to justify the title prefixed, I think it will be wise to postpone to a second opportunity my intention of doing so.—Yours, &c.

JOHN MACGREGOR.

BUSH'S PATENT COMPASS.

Sir,—It is a favourite idea with projectors of improvements in the ship's compass, that it is possible, by improvements in the compass itself, to obviate the effects of the local attraction of the iron of a ship. A little consideration will show that this is impossible, and that the attempt to do so can only arise from ignorance—the same kind of ignorance that would suggest the possibility of constructing a compass which should everywhere point to the true north, unaffected by the variation.

When there is no iron in the neighbourhood of a compass, the needle *ought* to point in the magnetic meridian. If it do not, the error must arise from one of two causes:

First. The axis of magnetism of the needle may not coincide with the axis of

figure. If the compass needle be a flat bar placed on its side, as is usual in the mercantile navy, the axis of magnetism is liable to shift, and this cause of error is very likely to operate.

Secondly. The friction between the cap and the point may prevent the needle when disturbed from returning to its proper place of rest. This cause of error must of course exist to a greater or less degree in every compass; its efficiency will be proportional to the weight of the card, and the weakness of the directive force of the needle.

Independently of these two sources of error, every compass placed in the same spot will point in the same direction. That direction will be the direction which a small magnetised needle suspended by a fine silk fibre would assume. (It will be observed, that I leave out of account the defects in compasses arising from imperfect graduation, centering, &c. These defects do not prevent the needle from pointing in the proper direction, although they give erroneous bearings of objects observed.)

If, now, we suppose iron, whether soft or hard, brought so near as to affect the small suspended needle, that needle will assume a new position. The line of magnetic action has changed its direction. That the needle points in a new direction is no defect in the needle: it is a confusion of ideas and a perversion of language to call it so. The needle would be faulty if it did not obey the new impulse. Every needle, whatever its construction, whatever its magnetic power, will, in the same position, have its original direction altered by exactly the same amount as the small needle I have supposed, except so far as friction may prevent any needle from taking up its proper position. I ought to observe, that I suppose the distance of the disturbing iron from the needle to be considerable, compared with the length of the needle. This is, or ought to be, the case on board ship; and unless this limitation is introduced into the investigation, it is impossible to compare the effect produced on one compass with that produced on another.

From these considerations it must be obvious, that to construct a compass which would not be affected by the approach of iron, would be impossible if it were attempted, and foolish if it were possible. Such insensibility could only arise from the instrument having too much friction in proportion to its directive power. The small needle suspended by a silk fibre, which is really the most perfect compass, will be most disturbed by the approach of iron, because its motion is least impeded by friction. Of common compasses, that which is most delicately suspended and has the greatest directive power in proportion to its weight, will be most disturbed, because friction will least interfere with its assuming its proper direction.

These remarks, Sir, have been suggested by an account given in your last Number of a patent (?) compass invented by Mr. Bush. This compass seems to be constructed with some idea of avoiding the disturbing effect of the iron of a ship. The idea is not apparent from the figure, and you, Sir, remark, I have no doubt with great justice, that "the theory is not very well made out in the specification." Some of the defects which the compass must have are, however, very obvious. Its weight must be very great compared to its directive power. It must, therefore, be very deficient in sensibility. We have what appears a proof of this given us in the article referred to; for when steel bars were placed in a position which caused a deviation of 30° in an Admiralty compass, they caused a deviation of only 6° in Mr. Bush's. Unless this difference arose from the steel bars being so near the compass that no conclusion at all could be drawn, it must have arisen from some defect in the construction of the compass which was least affected. Friction will prevent a needle from being so much disturbed as it ought to be by the approach of iron, but no conceivable cause can make a needle to be *more* disturbed by the approach of iron than it ought to be.

* *

Lincoln's-inn, April 21, 1846.

Note by the Editor.

The fact of Mr. Bush's compass being the subject of a patent seems to be doubted by our correspondent; we have both the patent and specification of it now before us. As intimated in our notice of the invention, we do not think "the theory" on which it is based in the inventor's mind is "very well made out," and it is no business of ours to

make out a good theory for him. Be it right or wrong, however, it is due to Mr. Bush that it should not be misrepresented. His idea is *not* that of "*avoiding* the disastrous effect of the iron of a ship," as "* * *" represents; he sees as clearly, as our correspondent does, the impossibility of that. But a thing which may not be avoided may nevertheless be neutralised, in the same way as in the compensating pendulum a high degree of expansion in one metal is corrected by a lesser degree in another. And something of this sort it is, which Mr. Bush professes to have accomplished. He seems to imagine that, by surrounding the magnetic needle with magnetic bars in the way represented in his figures, a resolution of forces takes place in the direction of the magnetic meridian. His own words are,—"According to my invention, the local attraction is caused to be *centralized* in or near the axis of the motion of the needle, whereby the needle of a compass is less prejudicially influenced, and will consequently act with more correctness, and, in fact, will be more similar in its performance and pointing, to what would be the case were there no iron or other causes of attraction in the locality in which a compass may be placed." Now, certainly, the *possibility* of this is not at all affected by anything stated by our correspondent; it may, or may not be true, for anything he advances to the contrary. Neither can it be truly said of Mr. Bush's compass—be the cause of its smaller rate of deviation what it may (on which point we admit the desirableness of further information)—that it is a "defect" in the instrument. The best of two instruments must surely be that which, under the like circumstances, points nearest to the meridian.

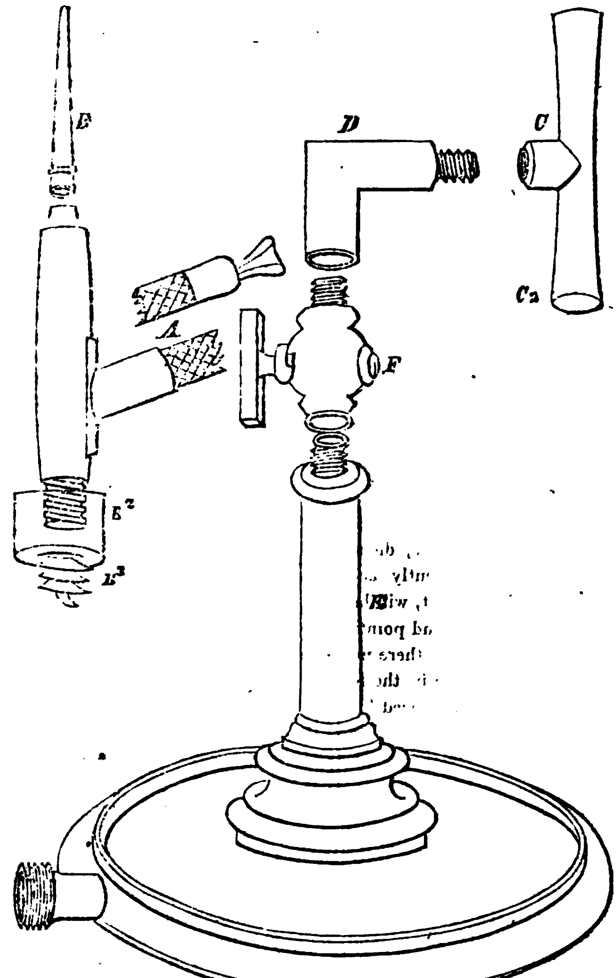
HERAPATH'S UNIVERSAL COAL-GAS BLOW-PIPE.

[Registered under the Act for the Protection of Articles of Utility. Mr. Wm. Herapath, of Bristol, inventor and proprietor.]

A is an elastic tube for the stream of air to the blow-pipe, B. When used with the mouth it has an ivory mouth-piece, but with the largest apparatus it is connected with a double bellows worked with a treadle.

B is the blow-pipe jet; it can be made removeable to vary the diameter of the jet; this is inserted into C^2, and, together, they form the gas blow-pipe in its simplest state, when by its wood-screw, B^2, it can either be fastened to a work-bench, to make a fixed vertical blow-pipe, or by its screw, C, can be fastened on an upright service-pipe, when it becomes a horizontal one with a circular motion. With the elbow-joint, D, and placed on a vertical service-pipe, it has both the vertical and the horizontal motion—everything which can be required from an instrument confined to one spot. In order to make the blow-pipe universal, it is only necessary to place it on the candlestick-foot, and by a vulcanised India-rubber tube join it to the service-pipe, when it is portable from one part of the workbench to any other.

This instrument seems likely to effect a complete revolution in such workshops as require heat to be applied over a space of a few inches by each operative; it can be used wherever coal gas is available, and its economy must be evident, as the stopcock will shut off nearly all the gas as soon as heat is not required, while it is always ready for recommencement; and, when in action, every modification of flame from the cone to a brushy one of 3 inches in diameter and 14 inches in length may be obtained. From this variety of power there are but few operations that the instrument is unequal to; the chemist, the silversmith, the glassworker, the brazier, the gasfitter, the tinman, and even the cook, can take advantage of it, and in a larger state, with a bellows worked by hands or feet, the blacksmith might resort to it. The inventor, Mr. Herapath, the eminent chemist, gives as familiar tests of its powers when urged by the mouth through a gas stream from a ¾ inch gas service-pipe, that he can blow a flint glass bulb of 4 inches diameter and a moderate thickness; or hard-solder a brass tube 2 inches diameter and 6 inches long; or melt six ounces of fine silver in a minute and a half. He raised an imperial pint of water from 50° Fahr. to 212° in an ordinary tin saucepan in two minutes, and a heavy copper soldering iron to the proper heat in one minute. It must not be overlooked, that this blow pipe possesses



an advantage over every other instrument of the kind, in admitting the use of *both* hands by the operator; as both the gas and the jet having fixed relations to each other, no hand is wanted for any other purpose than regulating the gas-cock when a variation of heat is wanted, and even that might be superseded by a crank on the cock, to be turned by the foot.

APPENDIX TO FIRST REPORT ON THE COALS SUITED TO THE STEAM NAVY. BY SIR HENRY DE LA BECHE AND DR. LYON PLAYFAIR.—(CONCLUDED FROM P. 405.)

Comparison between the Cornish Boiler and the Boiler used in the Experiments of the Commissioners—(Continued.)

If we compare the following analyses, it will be found that the Mynydd Newydd coals are so similar in their composition to those used in the Cornish experiment, as to be considered practically identical:

Analyses.

	Mynydd Newydd.	Cornish.
Carbon	84·26	84·19
Hydrogen	5·61	4·19
Ash...........	3·26	8·06
Sulphur........	1·21	1·90
Nitrogen.......	1·56	0·80
Oxygen	3·52	0·86
Total.....	100·00	100·00

The practical trial made on the Mynydd Newydd coal in the experimental boiler, gave 9·52 as its evaporative value; if, then, we assume that the two coals possess equal calorific powers, the evaporative values of the two boilers will evidently be as 9·52 is to 11·42; or, in other words, the Cornish boilers will be found to possess a superiority of nearly 20 per cent. over that used for the purposes of the investigation.

Assuming, then, the economic equality of these two coals, we have only to multiply the results obtained by the various coals during our own experiments by 1·1995, in order to ascertain their several evaporative values if consumed under the Cornish boilers.

The following Table has been calculated upon this assumption,* and should therefore be considered only as an approximation:

Name of Coal.	Evaporative Power, Commissioners' boiler. Actual.	Evaporative Power, Cornish boiler. Theoretical.	Name of Coal.	Evaporative Power, Commissioners' boiler. Actual.	Evaporative Power, Cornish boiler. Theoretical.
Mynydd Newydd........................	9·52	11·42	Bedwas................................	9·79	11·74
Graigola................................	9·35	11·21	Ebbw Vale	10·21	12·24
Anthracite (Jones and Aubrey)......	9·46	11·34	Porthmawr.	7·53	9·03
Old Castle Fiery Vein..................	8·94	10·92	Dalkeith Jewel Seam................	7·08	8·49
Ward's Fiery Vein......................	9·40	11·27	,, Coronation Seam	7·71	9·24
Bines	9·94	11·92	Wallsend Elgin	8·46	10·14
Llangennech	8·86	10·62	Fordel Splint..........................	7·56	9·06
Pentripoth................................	8·72	10·46	Grangemouth	7·40	8·87
Pentrifellin	6·36	7·62	Coleshill	8·00	9·59
Powell's Duffryn........................	10·149	12·17	Broomhill	7·30	8·75
Three-quarter Rock Vein	8.84	19·60	Lydney..................................	8·52	10·22
Cwm Frood Rock Vein	8·70	10·43	Slievardagh (Irish)................	9·85	11·81
Cwm Nanty-gros........................	8·42	10·10	Wylam's Patent Fuel..............	8·92	11·70
Resolven	9·53	11·43	Warlich's ,, ...	10·36	12·42
Pontypool	7·47	8·96	Bell's ,, ...	8·53	10·23

Another Report on the evaporative power of different sorts of coal (chiefly Welsh) is given by Professor Wilson and Mr. W. J. Kingsbury. Mr. Wilson visited all the shipping ports of South Wales for the purpose of making himself acquainted with and obtaining samples of those coals most approved of and best adapted for steam purposes. The Table on the opposite page gives the general results.

Section III.—Formulæ for estimating the evaporative value of fuel. By Messrs. Wilson and Kingsbury.

Section IV.—Chemical analyses of coals. By Mr. F. C. Wrightson.

Ditto, by Mr. H. How.

Calorific values of coals. By Mr. J. A. Phillips.

The method adopted by Mr. Phillips was to ascertain the quantity of litharge reduced by a given weight of each sort of coal. The coal was first reduced to a fine powder and mixed with the litharge; the mixture was then ignited; and the button of lead resulting from the fusion weighed. The value of a combustible, being in a direct ratio with the quantity of oxygen necessary to consume it, and the weight of the button being also in proportion to the amount of oxygen abstracted from the oxide, it follows that the latter must be an exact measure of the former. The coal which gave the heaviest button was James and Aubrey's anthracite (167·4); the least, the Dalkeith Coronation Seam (122·8).

* The Mynydd Newydd coal, supposing there was no loss of heat, is capable of evaporating 14·90 lbs. of water, and the Welsh coal (used in Cornwall) 14·28 lbs.; but considering that this heat cannot all be obtained in practice, these economic values for calculation might be taken as equal without introducing any serious error.

Table of the Results of Experiments made by Professor Wilson and Mr. W. J. Kingsbury.

Names of Coals employed in the Experiments.	Evaporating power, or number of pounds of Water evaporated from 212° by 1 lb. of Coal (economic.)	Weight of 1 cubic foot of the Coal as used for fuel. — Lbs.	Weight of 1 cubic foot of the Coal as calculated from the density. — Lbs.	Ratio of B. to C., or of the economical to the theoretical weight.	Difference per cent. between theoretical and economical weights.	Space occupied by 1 ton in cubic feet (economic weight.)	Results of experiments on cohesive power of Coals; per centage of large Coals.	Evaporating power of the Coal, after deducting for the combustible matter in the residue.	Per centage of residue in the Coals. — Mean.
	A.	B.	C.	D.	E.	F.	G.	H.	I.
Pentrifellin	6·36	66·166	87·726	·781	28·051	33·85	52·7	7·4	27·7
Duffryn	10·149	53·22	82·72	·643	55·43	42·09	56·2	11·80	7·81
Old Castle Fiery Vein	8·94	50·916	80·42	·633	57·946	43·99	57·7	..	6·57
Binea	9·446	57·08	81·357	·702	42·53	39·24	51·2	10·3	8·22
Mynydd Newydd	9.52	56·33	81·73	·689	45·09	39·76	53·7	10·59	8·28
Resolven	9·53	58·66	82·354	·712	40·39	38·19	35·0	10·44	4·71
Anthracite, Jones and Co.	9·46	58·25	85·786	·679	47·26	38·45	68·5	9·7	9·58
Ward's Fiery Vein	9·4	57·433	83·85	·685	46·	39·	46·5	10·6	7·44
Llangennech	8·86	56·93	81·85	·695	43·76	39·34	53·5	9·2	11·04
Three-quarter Rock Vein	8·84	56·388	83·60	·674	48·26	39·72	52·7	..	7·36
Graigola	9·35	60·166	81·107	·742	34·8	37·23	49·3	9·66	9·27
Lydney (Forest of Dean)	8·52	54·444	80·046	·68	47·02	41·24	55·0	8·98	4·06
Pentripoth	8·72	57·72	81·73	·705	40·17	38·80	46·5	8·98	10·47
Cwm Frood Rock Vein	8·70	55·277	78·299	·706	41·648	40·52	72·5	9·35	7·8
Cwm Nanty-Gros	8·42	56·0	79·859	·701	42·60	40·00	55·7	8·82	5·44
Wylam's Patent Fuel	8·92	65·08	68·629	·948	5·45	34·41	70·0	9·74	7·27
Grangemouth	7·4	54 25	80·48	·674	48·35	40.13	69·7	7·91	5·26
Broomhill	7·3	52·5	77·988	·673	48·55	42·67	65·7	7·66	3·23

EXPANDING ROSE-BIT, INVENTED BY JOHN HIPPESLEY, ESQ.

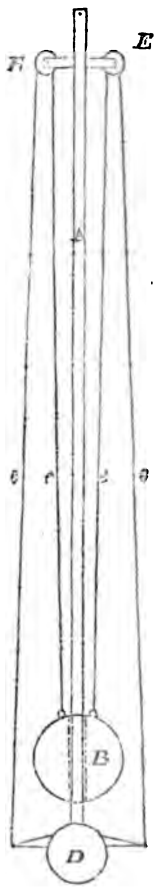
The rose-bit is a tool much used for light finishing cuts, in brass, iron, and steel. The extremity is commonly cylindrical, and the end is cut into teeth like a countersink. When it is supplied with plenty of oil, and there is but little stuff to remove, it acts very beautifully.

A valuable improvement in this instrument has lately been made by Mr. Hippesley, an amateur mechanic of Stoneason, and is represented in the annexed cut. It consists in making it expandible at pleasure, whereby one tool may serve to produce holes of various sizes. The body is made tubular, with three slits in it, reaching from the top nearly half-way down; and it is expanded by means of an internal stem, which is screwed into the lower end of the tube, and is of an enlarged size and conical form at the upper end (that next the teeth); so that as the stem is screwed forward the bit is expanded.

The rose-bit, both in its original and this its improved form, may be used without oil for ivory and hard woods, in which it makes a very clean hole.

A SIMPLE COMPENSATION PENDULUM.

Sir,—I beg to introduce to your notice a pendulum which, in my humble judgment, would keep correct time. The shaft, A, is provided with two bobs, the bob D, fixed, and the bob, B, moveable up and down the shaft. From D are projected two arms, to the ends of which are fastened silken cords, C, which pass up the shaft and over the pulleys, E, then descend and are fastened to the bob, B; so that when the shaft lengthens or shortens, the bob, B, rises and falls by means of the ropes, C. The reason of B being larger than D is to compensate the lengthening or hortening of the ropes; but this is so trifling as hardly to be deserving of notice. The relative weight of the bobs might be so adjusted that a perfect compensation might be obtained.



I am, Sir, yours, &c.,

C. BENTLEY.

114, Sloane-street, Chelsea.

A RELIC OF TUBAL CAIN!

Gilroy, in his "Art of Weaving," (1845,) quotes gravely a letter which he had received from one Alexis Kersivenus, dated Thebes, October 17, 1843, in which there is the following paragraph:—"No farther back than yesterday, about 5½ o'clock, P.M., some of Dr. Lipsius's workmen dug up an electrical machine bearing the name of that ingenious but ancient individual, Tubal Cain; and this instrument, according to the writer's statement, is the *only thing of the kind preserved from the wreck of the antediluvian world—Shem (the first son of Noah) having taken it with him into the ark!*"

SIR JOHN RENNIE'S ACCOUNT OF THE PLYMOUTH BREAKWATER.*

The Plymouth Breakwater is at once the most magnificent and the most successful public work which has been executed in Great Britain during the present century. (We say nothing of those still in progress—such as the New Palace at Westminster; we exclude also the Railways, which are not public works in the sense in which we here employ the term.) It has cost more than any other, and has also, we are glad to say, been productive of more unquestionable benefit. The total quantity of rubble deposited to form the Breakwater has been 3,620,444 tons; the quantity of masonry, 2,512,696 cubic feet; and the entire expenditure to this date, 1,446,963*l.* From nearly time immemorial, Plymouth Sound had been universally recognised as being, from geographical position, one of the most important naval stations in England; yet, naturally, it was of no use as a roadstead except in fine weather, and it had been the scene of frequent and disastrous shipwrecks; but by the erection of the Breakwater, it has been converted into a most safe and capacious harbour at all times and in all weathers, and has already been the means of saving many hundred vessels, of the Royal Navy and commercial marine, which would have been otherwise too surely added to the long roll of losses, caused by its originally unsheltered position.

The project of this Breakwater is supposed to have originated with Earl St. Vincent; but it was not till 1806, when the late Earl Grey occupied the post of First Lord of the Admiralty, that it was taken into serious consideration. Instructions were then given to the late Mr. John Rennie, Mr. Whidbey, master-attendant of Woolwich Dockyard, and Mr. Hemans, master-attendant of the Plymouth Yard, to make a survey of the Sound, and report on the feasibility of this mode of protecting it. These gentlemen, after a great deal of inquiry and consideration, finally recommended that—

"A detached or isolated solid mole or breakwater should be constructed of stone, near the centre of the Sound, upon the line of the Panther, Shovel, and St. Carlos rocks, 850 fathoms long, having the east end 60 fathoms west of the Shovel; the middle part to be 500 fathoms long in a straight line, and each arm to be 175 fathoms long, inclining 120° to the main arm. They proposed that this work should be raised at first only 10 feet above low water of spring tides, to be 10 yards wide at that level, and 70 yards wide at the base, in a depth of 5 fathoms; and that it should be formed by throwing down blocks of rough, unsquared stone or rubble, from 1½ to 2 tons weight and upwards in each block, which, they calculated, would form slopes of about 3 feet horizontal to 1 foot perpendicular, with a certain quantity of masonry above. They also proposed that another breakwater, consisting of two arms or kants, together 400 fathoms, or 400 yards long each, making an angle of about 40° with each other, and 120° with the eastern arm of the main breakwater, should be carried out from Staddon or Andurn Point—the end next to the shore not to be joined to it unless necessary, but to be left open to admit of a free circulation of tide through Bovisand Bay. By these two great works they expected that the Sound would be so well sheltered, that the whole space under the two breakwaters, amounting to about 2,000 acres, would be converted into a safe roadstead, capable of accommodating in perfect security, at all times, forty or fifty sail of the line of the largest class, besides a sufficient number of smaller ships of war and merchant vessels."

Five years elapsed—during which this Report was the object of a great deal of criticism, and other plans not a few were proposed—before any decision was come to by the Admiralty on the subject. It was then (1810) finally determined to adopt so much of the plan of Messrs. Rennie, Whidbey, and Hemans as embraced the formation of a breakwater near the centre of the Sound, and to leave the auxiliary pier from Andurn or Staddon Point for future consideration.

Mr. Rennie was appointed engineer-in-chief, and continued so till his death, Oct. 4th, 1821, when he was succeeded in that

* An Historical, Practical, and Theoretical Account of the Breakwater in Plymouth Sound. By Sir John Rennie, F.R.S., F.A.S., F.G.S., President of the Institution of Civil Engineers. Elephant folio. pp. 115. With 26 Plates. Bohn and Weale. 1848.

office by his son, Sir John Rennie. Mr. Whidbey was the first acting resident superintendent, and was succeeded by Mr. W. Stuart.

The first stone was deposited August 12th, 1812, and the bulk of the work completed in 1834; nothing more then remaining to be done, excepting "to supply or feed the mass with fresh rubble in proportion as it became consolidated by the sea, and drawn down to its permanent or ultimate section."

An authentic history of this great work, was as necessary to the honour of the country as the work itself was to its welfare; and by no one could the task of writing it have been more properly undertaken, than by the son of the eminent engineer, by whom chiefly it was planned (for hydrographic aid was all that his two colleagues, Messrs. Whidbey and Hemans, could pretend to supply), and who had himself so large a part in its execution. To this task Sir John Rennie brings, a perfect, and, in some respects, exclusive knowledge of the whole of the details of the undertaking, from first to last—a thorough intimacy with his father's views of the professional principles involved in it, and much anxiety to do adequate justice to the high sagacity and great practical skill observable in this, as in all his works—a laudable ambition to sustain, in his own person, the lustre of the distinguished name which he inherits—an earnest desire to benefit and elevate the profession to the top of which he had the honour to be raised, while composing the work—and, added to all these excellent qualifications, a spirit of liberality which has induced him to be wholly regardless of expense in his endeavour to execute worthily the high task he has undertaken. And most worthily, in truth, has it been executed. For general splendour in the style of getting up—for profuseness of costly illustration—for fulness and minuteness of detail—for completeness of documentary verification—it eclipses everything which has appeared in our times in engineering literature. Worthy it is of our noble Breakwater—worthy of the country—worthy of the name of Rennie!

The author gives, by way of introduction, historical notices of the district between the Tamar and Exe—of Plymouth, Devonport, and Stonehouse—which are followed by a description of Plymouth Sound, and the Admiralty directions for its navigation. We are then introduced to the circumstances attending the origin of the Breakwater, and the various plans proposed for the purpose. Next come the details of the various steps taken to carry out the proposed plan of Messrs. Rennie, Whidbey, and Hemans, including descriptions of the machinery, vessels, and implements employed—the prices at which the different parts of the work were contracted for—the quantities of work done from time to time, &c. These details are succeeded by (what would have better preceded them,) a "Narrative of the Progress of the Breakwater, the Effects of Storms upon it, and the various Alterations which have been made in it." The whole of this narrative is so interesting and instructive, that we have no fear of wearying our readers by transferring it entire to our pages:

"On the 1st day of April, 1812, the works commenced at Oreston, by building wharf and quay walls, opening the quarries, erecting cranes, &c.; operations were commenced about the same time in the Sound for laying down moorings to determine the exact line and position of the Breakwater; and on the 12th of August following, the birthday of His Royal Highness the Prince Regent, afterwards George IV., the whole of the preparations above described having been made, the first stone was deposited on the Shovel rock, nearly in the centre of the intended Breakwater, with considerable ceremony, in the presence of Lord Keith, the commander of the Channel fleet, accompanied by a large body of naval, military, and civil authorities, together with the officers belonging to the Breakwater establishment. It was considered advisable to commence at the centre, and carry on the operations from the centre towards each extremity, in preference to beginning at either end; because by this means the exact length could be regulated according to circumstances, and all interference with the currents of flood and ebb, or with the entrance and departure of vessels into or out of the Sound, would be avoided, and in order that the effect of the work might be determined.

In this manner the work was carried on until the 19th of March, 1813, when the rubble in places had been brought to within 5 feet of low water of spring tides; and on the 30th of the same month it made its appearance above low water of spring tides, by which time 43,788 tons had been deposited; and on the 30th of July following a length of about 720 yards had been raised up to the level of low water; and by the 25th of August following it had advanced so far that labourers could be employed upon it; and by the month of March, 1814, the work had made such progress that effectual protection could be derived from it, and vessels could ride at anchor with safety during gales where formerly it was dangerous to remain, and the vessels of war which previously used to anchor in Cawsand Bay, amongst others, the commander-in-chief's flag ship, the *Queen Charlotte*, 120 guns, anchored in the Sound under the Breakwater; a large French three-decker also ran in and came to anchor under the portion of the Breakwater above mentioned, with confidence, and rode out a tolerably severe gale without the smallest damage; thus, within the short space of eighteen months from the commencement of the work, its beneficial effects were apparent. The operations proceeded in this manner with considerable vigour until the 11th of August, 1815, when 1,100 yards in length of it were raised above low water of spring tides, and 615,057 tons had been deposited. On the 19th of November, 1814, it was decided to raise the whole work 20 feet above low water of spring tides, or 2 feet above high water of spring tides. This departure from the original intention (which was to raise it only to the level of 10 feet above low water of spring tides) was calculated to give great additional protection to the Sound, and render the anchorage much more secure, particularly for the smaller class of vessels, but for the large vessels the first idea was sufficient. It should be observed also, that although both Mr. Rennie and Mr. Whidbey mentioned 10 feet above low water, in the first instance, as the probable height to which it ought to be carried, nevertheless, they did not pledge themselves that this was to be the exact or final height, but reserved to themselves the power of being guided by circumstances as the work proceeded, the object at first being to give no more protection than was absolutely required for large vessels, and to obtain this object at as moderate a cost as possible; at the same time, it was also most important not to interfere with the currents of the flood and ebb, or to increase the tendency to deposit; but in proportion as the work proceeded they found that their calculations had been so well founded in every respect, that there was no increase in the tendency to deposit, or any sensible derangement of the tidal or fresh-water currents, and that the original estimate was so ample that they recommended that the whole length of the Breakwater should be raised 2 feet above high water of spring tides. Accordingly, the work proceeded above half tide without any material occurrence until the 24th of May, 1816, when in one week 5,329 tons of stone were deposited, and 332,407 tons during that year, which was the greatest quantity deposited in any one year. In the beginning of the month of November in that year, a series of heavy gales took place from the E.S.E. and W.S.W., which were the quarters of the compass most likely to affect the Breakwater; nevertheless, the whole of the work stood remarkably well, and without being injured or damaged by the gales in the least, although about 300 yards had been raised to the full height, viz., 2 feet above high water of spring tides; and the great mass of rubble, namely, one-third of the whole quantity, had been deposited along the whole line of the work. These gales, however severe, were followed by another gale still more severe on the 19th of January, 1817, which amounted to a perfect hurricane southward and westward during spring tides, which rose several feet above the usual height. At the time a considerable number of vessels were lying at anchor in the roadstead under the protection of the Breakwater, and rode out the gale with perfect safety; but unfortunately the *Jasper* sloop of war and *Telegraph* schooner had anchored without the line of protection afforded by the Breakwater, near the citadel, so that they experienced nearly the full effect of the gale; and, to add to the misfortune, they were less able to contend with the gale, in consequence, as it is said, of a portion of their crews being on shore at the time, so that they were driven from their anchors and wrecked under the citadel, and a melancholy loss of life took place. None of the vessels, however, in Catwater or Hamoaze, of which there were a considerable number at the time, suffered the least damage.

Upon examining the Breakwater after the storm, it was found that a length of about 200 yards of the rubble, of the upper part only, above low-water, had been displaced or deranged, and that several great blocks of stone, varying from two to five tons in weight, and upwards, had been thrown over from the south, or sea-slope, to the north, or land-slope, thus increasing the inclination of the former, or sea-slope, from

5 feet horizontal to 1 foot perpendicular, and in places rather more, instead of 3 feet horizontal to 1 foot perpendicular, at which it had originally been placed; and upon comparing the respective sectional areas occupied by the stone on the south or sea-side of the Breakwater, previous to its being displaced by the storm, with the sections occupied by the stone thrown over on the north or land-side of the Breakwater after the storm, it was found that, after making due allowance for the consolidation which the blocks had received previous to the storm, the one area was nearly equal to the other, so that the sea had thus nearly found its own slope, or the angle of repose at which the rubble would lie without being disturbed by the effects of storms similar or equal in force to those of January 19, 1817, before mentioned; thus completely corroborating the opinion and advice of the late Mr. Rennie, who always recommended (after it had been determined to raise the work above high water,) that the exterior or sea-slope of the breakwater should be laid at the angle of 11°, or 5 to 1, and calculated the quantity of stone accordingly; but the late zealous and indefatigable superintendent, Mr. Whidbey, was desirous of making the experiment in the first instance at an angle of 18°, or slope of 3 to 1, in order to ascertain whether it was sufficient, and to increase the sea-slope to 5 to 1 only in the event of its being necessary, and thus to economise the estimate as much as possible: so far, however, from the Breakwater having received any real damage from the storm, Messrs. Rennie and Whidbey observed in their letter of the 17th of April, 1817, to Mr. Croker, then Secretary to the Admiralty,—'Part of the stone was carried to the north slope, increasing the width northward, and the south slope was proportionably flattened; this lowered the top about three feet, but caused no alteration in any other respect, excepting that the work has become more consolidated, and been rendered much firmer than before, all the other parts remaining as they were previous to the storm; consequently, instead of considering that the work has been injured by the storm, we are decidedly of opinion that its stability is greatly increased by it, and it is only to be lamented that such a storm as that of January last had not happened a year sooner.' In works of this description, formed of loose blocks of rubble stone thrown together promiscuously into the sea, their specific gravity alone is not enough to wedge them sufficiently solidly together, so as to give them their ultimate angle of repose to resist storms, and this can only be effected by storms, which thus, in fact, become the best artificers. The work, therefore, can never be made sufficiently permanent until it has withstood the shock of the most violent storms. They, therefore, recommended that the whole of the work should be raised to the height of the highest part left by the action of the sea in that storm, and in the form and slope given to it by the sea, and that it should remain in that state until the whole length was finished, by which time they expected that every part would have been sufficiently consolidated so as to become, to a certain extent, immovable, after which they would be able to judge whether it would be advisable to set the surface-stones in a regular form, with masonry casing, or otherwise. Upon this plan the work accordingly proceeded for a time. Mr. Whidbey, however, still considered that the slope of 3 to 1 required further experience before it was abandoned; and in this manner he continued it without any alteration worthy of remark until 1824, by which time by far the greater portion of the rubble had been deposited along the whole face of the Breakwater, amounting to 2,381,321 tons, or two-thirds of the whole quantity which was raised above the level of low water; and the whole of the main and 200 yards of the west arm, making altogether 1,241 yards in length, had been raised to the full height, viz., two feet above the level of high water of spring tides. In proportion, however, as it was raised to its full height, and advanced towards completion (as might be naturally supposed), the waves during storms meeting with greater resistance, had a greater effect upon it, and, consequently, greater precautions were necessary to secure it; for so long as the work was only raised to the level of half tide, the resistance offered to the waves was comparatively trifling, and that only for a short period of the tide, consequently, a less slope was required; but as soon as the whole of the main arm and part of the eastern and western arms had been raised above high water, then it presented an extended line of resistance, against which the waves broke with accumulated force, and it became evident that increased strength was necessary to withstand the shock of the waves without alteration of form.

The upper part of the work, which had been deranged by the storm of the 19th of January, 1817, was soon restored to the state in which it was previous to that storm, and in this manner it was continued until the 23rd of November, 1824, when another terrific hurricane occurred from the SS.E. to S.W., equal in violence, although of longer duration, than the storm of the 19th of January, 1817, before mentioned; this

also occurred during a spring tide, which rose seven feet beyond the usual height, and three feet higher than had ever been known before. The effects of the gale of November, 1824, were precisely similar to those of the storm of the 19th of January, 1817, before mentioned, although to a greater extent, inasmuch as the waves had a much greater length to act upon. The sea slope was again altered by the storm; out of 1,241 yards which had been raised to the full height, 796 yards were again deranged, leaving 445 wholly at the east end scarcely altered, and the slope of the part deranged was increased to 10° 47′, or nearly 5¼ to 1, instead of 18°, or 3 to 1, at which it had been set; and the superfluous stone, amounting to several thousand tons, was thrown over to the north or inner slope, and the areas of the spaces on the south or outer slope, from whence the blocks had been taken, were nearly equal to the areas of the spaces subsequently occupied by them on the north or land slope, thus again giving additional corroboration to the opinion of the late Mr. Rennie, who always recommended that the sea slope ought to be extended to 5 to 1, although the well-intentioned anxiety of Mr. Whidbey, in order to economise and reduce the estimate, induced him still to adhere to the slope of 3 to 1. It is worthy of remark, however, that no part of the work below low water was disturbed by the gale, and that the effects, such as they were, commenced at low water, and increased from thence upwards to the top; that these effects were merely superficial, without injuring, in the least degree, the body of the work, on the contrary, rendering it more solid; in fact, the result of the gale could not be considered injurious, but rather beneficial than otherwise, by disposing of the upper surface of the mass in a form better calculated to resist change and ensure permanence, which otherwise must have been done by artificial means, and at greater cost. Mr. Rennie unfortunately died on the 4th of October, 1821, otherwise it is more than probable that he would have succeeded in persuading Mr. Whidbey to follow the increased slope of 5 to 1, before the effects of the storm of 1824 had again established the important fact, by the best of all teachers, viz., experience, that nothing less than a slope of 5 to 1 between high and low water was adapted to withstand undisturbed the effects of storms such as the Breakwater in Plymouth Sound was continually exposed to.

The Admiralty, before proceeding further, decided upon consulting (May 13, 1825,) the late Mr. William Chapman, Mr. Josias Jessop, Mr. George Rennie, and the present Sir John Rennie, as to the most advisable course to be adopted in the future management of the work. These gentlemen visited the Breakwater in company with the superintendent, Mr. William Stuart, and, after inspecting the work and hearing all the evidence, and investigating thoroughly the whole of the circumstances connected with the past history of the work, and its actual state, were unanimously of opinion that it had received no real injury, and decided upon recommending that the following measures should be adopted for carrying on the remainder:

First. That the slope of 5 to 1, as shown by the experience of storms, should be adopted for the sea slope.

Secondly. That in order to give the mass of the work greater stability, the largest blocks should be selected, and that the surface of the sea and land-slopes, as well as the top, should be paved with them.

Thirdly. That as the upper part of the Breakwater had been so much altered in form by the storm of November 23, 1824, it would be better to transfer or remove the centre line 36 feet further northwards or inland.

Fourthly. The top width should be reduced from 50 feet, which it was previous to the storm of 1824, to 45; by this means the outer or sea slope would be formed on the more solid part of the work, and any addition which might be necessary could be more easily made on the inner or land side.

Fifthly. That the top or base of the sea slope should be laid on that part of the work which had been well consolidated, and that it should be carried upwards to the top at the angle of 11°, or 5 to 1.

Sixthly. That the top should have a curve of 1 foot in the whole width of 45 feet, which would allow for any subsidence, and serve to throw off the waves more effectually.

Seventhly. That the inner slope should be set at the angle of 26°, or 2 to 1, which was nearly the same as left after the storm.

Eighthly. That by way of giving additional security to the base of the outer or sea slope, it was recommended that there should be a course of granite masonry, composed of large blocks, well squared and dressed, and firmly imbedded horizontally at the level of low water of spring tides, and set in Roman cement, and well dovetailed, dowelled and lewised together with strong iron bolts run in with melted lead.

The Admiralty, to whom these recommendations were addressed, approved of them, and ordered them to be carried into effect. The works accordingly commenced upon this system, and were continued from the centre to the westward. This was a

great improvement upon the system of the upright slope, adopted by Mr. Whidbey; but in proportion as the work advanced, it was found that the sea accumulated with more violent effect, and the rough paving of the rubble alone was scarcely sufficient to withstand its effects without a certain degree of alteration. The present Sir J. Rennie, after consulting with Mr. Whidbey and Mr. Stuart, recommended that, in addition to the lower or basement course of granite above described, another course of granite of similar dimensions should be used half way up the sea slope; that a third or single wedge-shaped course of granite should be used at the top, at the intersection of the sea or outer slope and the top; that the intermediate spaces between the granite-bonding courses should be filled with square blocks of limestone ashlar, set at right angles to the face of the slope; and that the inner slope, which was comparatively very little exposed, should be paved with the best blocks of rough rubble limestone, selected for the purpose. These additional works were effectual for the main and eastern arm, but in proportion as the work advanced to the westward, the waves were found to have greater effect upon it, and consequently greater precautions and strength were still found to be necessary in order to resist them. Sir J. Rennie was therefore directed by the Admiralty to prepare detailed drawings and specifications, pointing out the mode in which the different parts of the Breakwater should be finished. Finding that the greatest difficulty consisted in preserving the base of the sea slope from being undermined, however well the basement granite courses, above mentioned, were prepared and set, he recommended that an additional width should be given to the berm, benching, or foreshore of rubble, previously recommended in his joint report with Messrs. Chapman and Jessop, to be placed on the outside of the whole line of the Breakwater, which foreshore he proposed to raise just sufficiently above the level of low water to protect the toe or base of the lower course of masonry from being undermined by the recoil of the waves, and at the same time to break and disperse them before they reached it. This benching or foreshore, he proposed should be 40 feet wide at the centre of the main arm, and increase to not less than 50 feet wide at the commencement of the western arm, and be continued of the same width to its termination; and to diminish to 30 feet wide at the eastern extremities of the main and eastern arms; that the surface of this foreshore should be raised to the level of about 2 feet above low water of spring tides, next to the toe or basement course of the outer or sea slope; and that it should increase to 5 feet above low water, at 15 feet from the outer edge of the berm or benching, in order to break the waves before they reached the main body of the slope, and to check their recoil, which was found to produce considerable effect, and to allow for subsidence. He also recommended that the whole surface of the foreshore should be roughly paved with the largest blocks of limestone, and that in proportion as the paving of the upper part of the Breakwater advanced towards the west end, the whole surface of the sea slope and top should be cased with courses of well-squared ashlar limestone masonry, solidly bedded horizontally upon the interior rubble below, in addition to the exterior masonry casing above described, which was to be set at right angles to the slope; and that the extremity of the western arm should be finished with a circular head of solid masonry, 75 feet in diameter at top; that the circular head upon which the foundation of the lighthouse was to be placed, should be formed by an inverted arch resting upon one or two horizontal courses, founded from four to five feet below low water of spring tides; and that the whole of the circular head, as well as a length of 120 yards next to it, should be made of solid masonry, granite being used at the bottom, centre, and top of the outer slope, and the rest of limestone, the whole being well squared, dressed, and dovetailed, lewised and dowelled together; the exterior courses being radiated and set at right angles to the surface of the slope, and set in Parker's or Roman cement, and that the eastern arm should be paved with masonry also; but as it was not so much exposed, and as the waves were not so violent there, the solid horizontal courses might be dispensed with, and that its extremity should also be finished with a circular head of masonry.

The rubble and masonry casing proceeded in this manner according to the plan last recommended until the year 1830, when Mr. Whidbey retired, and the Admiralty determined to contract for the completion of the whole of the rubble, part of the work still remaining to be done, and afterwards to undertake and complete such portions of the Breakwater with masonry as appeared desirable. Upon this plan Messrs. Johnson took the contract, which expired in 1834. By this time, the great mass or bulk of the rubble had been deposited; it was only, therefore, necessary to supply or feed the mass with fresh rubble, in proportion as it became consolidated by the sea, and drawn down to its permanent or ultimate

section. The supply to make good these deficiencies has gradually become less every year, as appears from the quantity of rubble deposited yearly from the commencement of the work. In 1846, only 22,850 tons were deposited, and up to the middle of the present year only 10,025 tons have been deposited; and, probably, a similar quantity may be required during the remaining portion of the year, and the same quantity next year. This, however, is so trifling, compared with the mass and extent of the work, and amounting merely to the annual cost of £1,000, that it is much less than what might have been reasonably expected: indeed, the whole mass of the work has become so solid, that it forms, as it were, one great stone; and in those parts where it has become necessary to remove a certain portion of the rubble to complete the general form of the masonry casing, it has been found to be so solid, that it is very difficult to remove it. The masonry casing also remains firm; scarcely any stones have been removed for several years past, and in those places only where the masonry had been put upon the rubble comparatively recently deposited, and which had not had sufficient time to become solid, so that during subsidence the masonry above it necessarily became deranged to a certain extent; but wherever the rubble has been deposited a sufficient time, and has been exposed to the consolidating effects of the waves, the whole mass has become as hard and as solid as if it had been laid artificially; and where it was necessary to remove any of the upper part, in order to bed the stones for the casing more thoroughly, it could only be effected as if working it out from a quarry; and all the blocks composing the exterior surface of the work, as far as could be perceived below low water, and even to the bottom of the sea, were covered, for the most part, with seaweed, which is an evident proof that they had not been disturbed, and had obtained their ultimate slope or angle of repose. That a few detached stones may be removed occasionally, under extraordinary circumstances, may be expected; for, under any system, it is impossible to avoid the necessity of those occasional repairs to which every work is liable, more particularly those which are exposed to the action of heavy waves during storms at sea: these casualties, however, cannot be considered as drawbacks upon the system; on the contrary, they are so trifling, that they more and more confirm the superiority of the system adopted.

Sir John Rennie adds an account of the lighthouse erected on the west end of the Breakwater, and the beacon raised on the east end, according to the plans of Messrs. Walker and Burgess, engineers to the Trinity House.

The work concludes with a vindication of the Plymouth Breakwater from the censure of its system of construction, contained in the last Report of the Commissioners on the proposed Harbour of Refuge in Dover Bay. The Breakwater, as our readers have seen, was constructed (latterly) with a slope of 5 to 1. The Dover Harbour Commissioners recommend that all sea-walls should be vertical! Sir John Rennie appears personally to great advantage in his refutation of this modern crotchet. It is written with a great deal of ability, and is, to our mind, perfectly conclusive on the subject.

PREVENTION OF PRIMING.

Sir,—Marine boilers (especially tubular) very generally "prime" on leaving port, or on the vessel's entering a river, as well as at other times from other causes. In practice, the injection of tallow, oil, or other fatty substances, has been attended with very beneficial preventive results.

Many boilers are not fitted with the "double cock grease cup," for the above purpose. The following plan I have found effective; and, as I believe it to be original, offer it, through the medium of your Magazine, to all whom it may concern.

Suppose the three gauge cocks of the "gauge glass" to be represented by the letters, A, B, C; A being the top cock. Shut B and open C—steam will escape through C and fill the glass tube with steam. Then place a vessel of melted tallow or oil to the pipe of C, and shut A; the steam in the glass will then be condensed and replaced by the tallow. Next shut C and open A and B.

If the water in the boiler be one-fourth up the glass, three-fourths of the contents of the glass will enter the boiler each time of application.

The contents of two gauge glasses checked the priming in a boiler of 120 horse power engine.

This plan can be applied with other known methods, as blowing out at inter-

vals. When dirt is the cause, the latter method is to be preferred; but the first will enable the engineer to know the whereabouts of the water level.

I am, Sir, yours, &c.,
W. SCOTTEN, Engineer, R.N.

Royal Yacht Victoria and Albert,
April 19, 1848.

ECONOMICAL PROCESS OF MAKING BICHROMATE OF POTASH FROM THE CHROMATES OF LEAD AND THE BICHROMATE OF LIME. BY M. V. A. JACQUELAIN.

This process was performed, for the first time, in June, 1845, upon a quantity of 10 kilogrammes, at the establishment of M. Guerin, late Professor of Chemistry in the Normal School. Afterwards, in the month of September, of the same year, the experiment was repeated with 50 kilogrammes of chrome ore, near Rouen, by M. Maze, manufacturer of soda, and one of our most skilful operators.

M. Allain, on his part, published, in November, 1846, in the *Revue Scientifique*, a process which resembles mine, so far as regards some of the primary materials; but that which I am now about to set forth differs from the preceding in the details of execution, and in the study of the principal phenomena, a perfect knowledge of which is inseparable from all industrial enterprise.

Explanation of the Process.—1. Mix together, in casks revolving upon their longer axes, chalk and chrome ore, previously reduced to a very minute state of division. This tenuity of the ore may be obtained by pulverization, and then passing it through a very fine sieve; for it is important, above every other consideration, to have an impalpable powder, for reasons which will be presently shown.

2. Calcine this mixture for nine or ten hours at a lively red heat, upon the hearth of a reverberatory furnace, taking care to spread it to a thickness of five or six centimètres, and to stir it well ten or a dozen times with a rake or poker.

At the end of this time, if the flame has been sufficiently oxidating, the conversion of the oxide of chrome into chromate of lime will have been accomplished. This may be ascertained, first, by the appearance of the material, which will be of a yellowish green colour;* and next, by its having the property of dissolving completely in hydrochloric acid, with the exception of the sandy portion.

3. Having proceeded thus far, the material, now very friable and porous, is next ground fine, and diluted with warm water. The liquid mass is constantly stirred, while sulphuric acid is added until the liquor will slightly redden blue litmus paper. This character is an indication of the total conversion of the chromate of lime into a bichromate, and of the formation of a little sulphate of the sesquioxide of iron.

4. Diluted chalk is then added, little by little, to the liquor, until the sesquioxide of iron is completely eliminated. In this the bichromate of lime undergoes no change as to its condition of saturation.

5. After remaining a short time at rest, the supernatant clear liquor is drawn off—this contains only the bichromate of lime, with a very little sulphate of lime. In this condition it may be immediately used for the production of bichromate of potash, the neutral or basic chromates of lead, and even the chromates of zinc, of which the approaching use may be foreseen, inasmuch as the oxide of zinc has already been so happily substituted for the carbonate of lead in white oil painting.

It will be seen from the preceding, that it is not necessary to use the bichromate of potash in order to obtain the insoluble chromates of lead, zinc, baryta, &c., and this should bring about a great economy in the preparation of these articles. It is sufficient, therefore, to produce a double decomposition between the bichromate of lime and the acetate, the sub-acetate of lead, the chloruret of zinc, and so on of others.

With regard to the bichromate of potash, it is produced not less easily, nor less pure, by causing a reaction of a solution of carbonate of potash freed from soda, upon the bichromate of lime, from which results an insoluble carbonate of lime, easily washed, and bichromate of potash in solution, which must be concentrated and crystallized under protection from dust, and all access of hydrochloric acid.—*Comptes Rendus.*

* This singular peculiarity of the chromate of lime with an excess of base, of preserving the green tint of the oxide of chrome, gave rise to the belief, for a long time, that it was not produced by the chromate of lime, and the more so, as this chromate is hardly soluble in water.

Passage of Gases through one Another.—If a liquid be interposed between the two poles of an electric battery and the body to be decomposed, the acid or the oxygen is found to pass through that interposed liquid to the positive pole, the hydrogen and the matter of the base to the negative pole, and without acting upon the substance of the interposed liquid. Thus, suppose a vegetable colour to tinge the water in an intermediate cup, acid will pass through it without reddening it, and alkali without making it green. Nay, an acid will pass through an alkaline solution, or an alkali through an acid, without uniting in either case to form a neutral salt, unless the neutral compound is insoluble—for in that case it falls to the bottom.—*Lord Brougham.*

Isinglass Cement.—"W. Spence."—The stringiness complained of may be avoided by soaking the isinglass in cold water till it swells, before dissolving it in the spirits of wine.

Dry Gas Meters.—"A Peruser of the Magazine."—It is *not*, by any means, an "established truth," that dry meters are better than wet; neither is it true that the particularly well-puffed dry meter alluded to is the best of any. We believe that sufficiently accurate results for all practical purposes may be obtained by both sorts of meter.

Wire Gauges.—"What is the rule by which the *wire gauges* (*i. e.*, the common Birmingham) are graduated? *A Constant Reader, Lewes, March* 25."—The Birmingham wire gauge is graduated from 4 thousandths of an inch (·004) =1·250th part, up to 454 thousandths of an inch (·454) =4½ tenths.

Braiding.—"G. L."—In the mode of weaving called braiding, the threads cross each other in diagonal lines, the consequence of which is, that articles made in this way, such as elastic braids, become narrowed in proportion as they are stretched. But a new sort of elastic braid has been lately introduced, by Messrs. Turner and Pegg, of Leicester, which are woven with a shuttle in the ordinary manner of plain weaving, so that the threads cross each other at right angles. By this alteration in the formation of the fabric, this important improvement is effected—that to whatever extent the fabric may be stretched lengthwise, it remains always of the same breadth.

Rapid Firing—The Tangent Slide.—"Miles."—We dare say friction-rollers might be employed with advantage to facilitate the working of ships' guns, and we have no doubt that any suggestion to that effect, would receive due attention from the Board of Ordnance, to whose province such matters belong. The "Tangent Slide" referred to by the same correspondent, which is now in general use both in the army and navy, was invented by General Shrapnel, the inventor of the celebrated Shrapnel Shell.

The Cantelonian System of Incubation.—"A Subscriber (Cork)."—Apply to Mr. Cantelo, 450*a*, Strand.

"*No Proof of the present Existence of any of the Stars.*"—*A Star-gazer*, who questions the truth of a notice under this head, which appeared in No. 1255, is recommended to peruse a small treatise called "The Stars of the Earth," published by Baillière, 1847. The following are some of the conclusions which he will there find indisputably established:—"We do not see the moon as it is, but as it was a second and a quarter before; i.e., the moon *may already have been dispersed into atoms* for more than a second, and we should still see it entire and perfect. We do not see the sun as it now is, but as it was eight minutes before; Jupiter as it was fifty-two minutes; Uranus as it was more than two hours before; the star in Centaur as it was three years ago; Vega as it was nine and a quarter years; and a star of the tenth magnitude as it was *four thousand* years ago."

Teeth and Cogs.—"F. M."—Both things perform the same office, yet each with a difference. A *toothed* wheel is one the teeth of which are of the same piece with the body of the wheel; a *cogged* wheel, one in which the teeth or cogs are made of separate pieces and let into the wheel.

Cast Steel Manufactures.—"By bringing the following queries under the notice of persons practically acquainted with the subject, you will probably elicit answers of value to many besides the inquirers; viz.—Can small articles be cast, of cast steel, with any degree of sharpness; and by what means?—Can these cast steel articles, so cast, be made to receive any degree of hardness; and by what methods would such steel, when annealed, be capable of being turned?—Which is the best mode of proceeding in making and melting of cast steel, as regards fluxes, heat crucibles, &c.?" —*J. & W. Dean, Newcastle, March*, 1848.

Building Stones.—"N. B."—The stone employed in the construction of the New Palace, Westminster, is from the Bolsover quarries, and was preferred on the recommendation of a commission appointed by government to ascertain the sort of stone best fitted for the purpose. Architects are by no means, however, of one opinion as to its superiority—many of them still inclining to the Portland, of which some of the best of our older public buildings are constructed. The Reform Club House—a recent structure—is built of the Portland stone.

Blackfriars Bridge.—"An Architect."—The statement made in Robison's "System of Mechanical Philosophy," that the arches of this bridge are surmounted by counter arches, was confined to the earlier editions of that work, from some one of which it is, no doubt, quoted by our correspondent. In the last edition, by Sir David Brewster, the statement is corrected. The bridge which Professor Robison had in view, was Westminster Bridge, where this mode of construction was first introduced by Labelye.

Soda from Sea Salt.—"S. C. E."—The prize offered by Buonaparte was £40,000, and it was awarded to the French chemist, Leblanc. Soda had been previously obtained from barilla, but, in consequence of the war with this country and the blockade of the ports of Spain, from which the French, as well as other nations, derived their chief supply of barilla, the price of the article, and of soap and glass, to the manufacture of which soda is indispensable, rose to such a height as to make it an object of the greatest national importance to discover a substitute. Leblanc's process consisted simply in converting the sea-salt into sulphate of soda by the addition of sulphuric acid—both of them among the most abundant and cheap of substances. The result was, not only to supersede in France the use of barilla for the manufactures of soap and glass, but throughout the world: one of the few instances in which war has been of benefit to mankind.

Swiftness and Velocity.—"The members of an Elocution class would be obliged to the Editor of the *Mechanics' Magazine* to favour them with his opinion whether the terms *swiftness* and *velocity* are perfectly synonymous? Turner, in his 'English Composition,' (Parker's edition,) says they are. Tower Hamlets, April 9th."—Turner is a very respectable authority; but in this instance we must differ from him. We apprehend that the one term can only be properly used to describe the motion of animate bodies—the other, that of inanimate. A bird flies with *swiftness*—the *swift*, for instance; a cannon-ball is propelled with *velocity*.

Green Vitriol.—"J. Y."—The green vitriol of commerce is more commonly called copperas, from a popular misconception of its true nature; for it is a sulphate of iron and not of copper. It is the *blue* vitriol alone which is entitled to the name of copperas.

The Quadrature of the Circle.—"D. R. Q."—Not only is there no reward offered by any public body for the solution of this problem, but both the Royal Society of London and French Academy of Sciences have, for many years, made it a rule not to look at any paper on the subject. "This problem," says Professor De Morgan, "is never now attempted (in print, at least,) except by those who are altogether ignorant of mathematics, or add a most undue opinion of themselves to an acquaintance with the elements only."

Pendulum Saws.—"An Intending Colonist."—Two saws to be worked by a pendulum put in motion by hand, were described in vol. ii. of this Journal,

p. 49; and vol. iii., p. 1. The same mode of actuating saws had been often proposed before. In Besson's *Instrumentarum*, 1578, there is a figure of a saw-cutting machine worked by a pendulum, pulled like a church bell, and acting through the medium of a right and left-handed screw and a system of diagonal links, in the manner of the well-known lazy tongs.

Hollow Shot.—"Hibernicus."—The following extract from Captain Simmons' book on "Heavy Ordnance," will probably furnish our correspondent with all the information he requires:—"The adoption of hollow shot is tantamount to recurring to projectiles, which have been long exploded by all nations but the Turks; it is equivalent to using granite shot. It matters little, for practical purposes, what the projectile be formed of, so that its density be what we desire. Whether it be hollow iron or solid granite, if its volume and specific gravity be the same, the effects will be nearly identical. Now, the granite shot which fell on board the *Windsor Castle*, in forcing the passage of the Dardanelles, in 1807, and nearly cut her mainmast in two, is said to have weighed 800 lbs.; consequently, its diameter would be 24·1473 inches. A shell of iron of this diameter, and 3·8265 inches thick, will exactly weigh 800 lbs. The historian, Guicciardini, who was also distinguished as a general officer, writing in the beginning of the sixteenth century, speaks of the introduction of iron shot, by the French, in the campaign of 1494, as a vast improvement in the service of artillery, and this belief has never since been questioned, except by the inventors of the carronade and the promoters of this same system, improved by M. Paixhans. The invention of hollow shot did not stand its ground on the introduction of carronades, nor will its use, it is firmly believed, be extended to the end of the first year of a war."

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in machinery for burring, ginning, and carding wool and cotton, or similar fibrous materials requiring those processes. (Being a communication.) April 27; six months.

Edward Walmsley, of Heaton Norris, Lancashire, cotton spinner, for certain improved apparatus for preventing the explosion of steam boilers. April 27; six months.

William Henry Barlow, of Derby, civil engineer, and Thomas Forster, of Streatham Common, Surrey, gent., for improvements in electric telegraphs, and in apparatus connected therewith. April 27; six months.

Thomas Edmondson, of Manchester, machinist, for improvements in marking and numbering railway and other tickets or surfaces, and in arranging and distributing tickets. April 27; six months.

Daniel Rice Pratt, of Worcester, Massachusetts, America, for machinery for connecting railway carriages. April 27; six months.

James K. Howe, of New York, America, for improvements in building ships and other vessels. April 27; six months.

Roger George Salter, of Birkenhead, Chester, surveyor, for certain improvements in carts for the distribution of liquid substances, and in the construction of drains, sewers, and cesspools, and in the cleansing of the same. April 27; six months.

Charles Fielding Palmer, of Birmingham, for a new or improved chalybeate water. April 27; six months.

Alexander Parkes, of Birmingham, experimental chemist, for improvements in the manufacture of metals, and in coating metals. April 27; six months.

NOTICES TO CORRESPONDENTS.

The Supplement to the last Volume, containing Title, Index, &c., is published along with the present Number, and will also form part of our forthcoming Monthly Part.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

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Edited by J. C. Robertson, 166, Fleet-street.

GARD'S PATENT BORING AND SINKING MACHINERY.

Fig. 6.

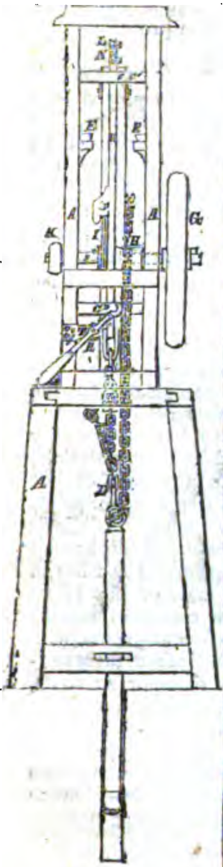


Fig. 1.

Fig. 2.

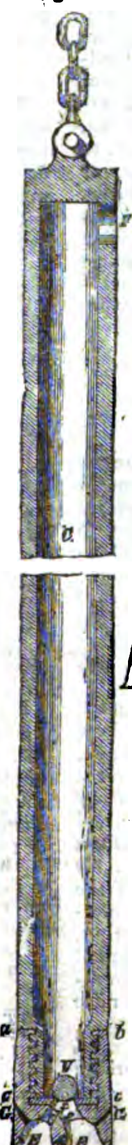


Fig. 5.

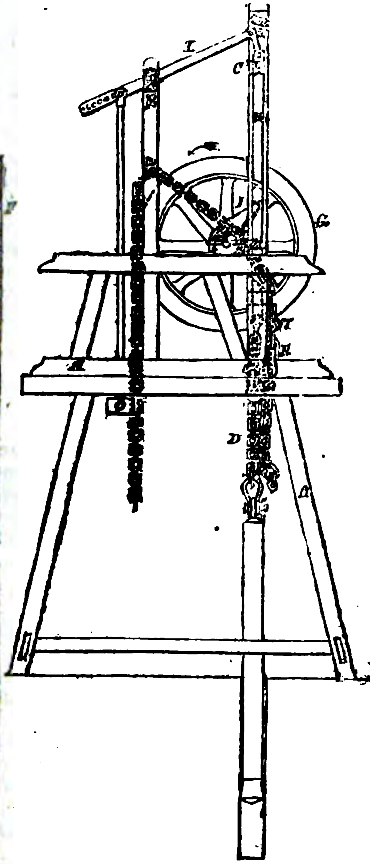


Fig. 4.

Fig. 3.

GARD'S PATENT BORING AND SINKING MACHINERY.

[Patent dated October 21, 1847. Patentee, Mr. William Gostwyck Gard, of Calstock, engineer. Specification enrolled April 21, 1848.]

Boring the earth to great depths has been always hitherto a very tedious and expensive process, and it has, in consequence, been one of very limited use. In mining, where it might be universally employed with the greatest advantage, for drainage and ventilation, it has not, we believe, been had recourse to for these purposes at all, being merely used in a tentative way, to ascertain the existence, or depth, or direction of mineral veins and seams. The most essential service which it has yet rendered, has been to the Artesian system of well-sinking, and that solely because it offered the only possible means of accomplishing the object in view. Much was expected from the improved plans of Beart, of our own country, and Fauvelle, of France (see *Mech. Mag.*, vol. xlv., p. 308); but neither of them can be said to have been as yet productive of any very decided results.

The chief sources of the tediousness and expense of boring, as now commonly conducted, are, *first*—the employment of borers, which require to be raised to the surface every time they become filled or clogged with the *débris* or sludge; and *second*—the connecting of the borer with the working power employed, by means of jointed rods; the constant screwing and unscrewing of which involves an infinity of trouble.

By the improvements which we are now about to describe, the first of these objections is, to a great extent, obviated, and the second entirely so. The borer is so constructed as to take up *within itself* the borings as fast as they are made, and pass them upwards into a hollow shaft of considerable capacity; so that, for forty, or fifty, or more raisings of the borer to the surface, and as many interruptions to the progress of the boring, one only will suffice. Again: instead of jointed rods, Mr. Gard employs a continuous chain or rope to lower and raise the borer.

A further and most important improvement of Mr. Gard's, consists in working the borer by means of machinery so constructed that the borer makes a perfectly round hole at one and the same operation, and descends always with one uniform force, no matter what the depth of the boring may be—the extra length of chain or rope being regularly counterbalanced as the operation proceeds.

I. *The Borer*.

The borers usually employed are sometimes made of a round form, like the shell-bits and nose-bits used in carpentry; at other times they are made of a straight, chisel-like form, with a hollow shaft or handle; and the borings, when they rise up around the tool to the height of the shaft, pass through an orifice into the hollow of the shaft. Sometimes, also, borers of the description last mentioned have been surmounted by hollow cylinders, screwed or otherwise fixed into them, which have served as additional receptacles for the borings. All these forms of borers have this defect—that they become speedily encumbered by the bored-out materials, which accumulate to a greater or less extent around the cutting edges or points of the tools, and are consequently difficult to work. Now, the nature of this branch of Mr. Gard's improvements consists in making the cutting ends or bits of an inverted, cup-like, or concave form, divided by a cross into four segments, with apertures leading directly from these segments into a hollow cylinder or shaft, screwed into the neck of the bit, whereby the bored-out materials are removed out of the way of the cutting edges, almost immediately after they are detached from the perforated strata, or, at least, much sooner than by any other boring machine or tool now in use.

Fig. 1 of the accompanying engravings is an external elevation of a borer on this improved plan; fig. 2 a sectional elevation of it; fig. 3 a bottom plan, and fig. 4 a plan on the line *ab*. A is the concave boring-bit. Externally, this bit is of a cylindrical form from the point, *c*, downwards, but from *c* upwards it is slightly tapered, there being a difference of about half an inch in the diameters at top and bottom. B is the cross by which the interior concave space is divided into four segments, E, E, E, E. The under or cutting edge of the circular part of

the bit is made with a single bevil, inclining inwards, so as to throw all the borings inwards; but the under edges of the four arms of the cross are made with double bevils, and convex. The body of the bit is made of wrought iron, but all the other under or cutting edges are of steel. C is the hollow shaft, which is screwed into the neck or tapered part of the bit; it may be of any convenient length. C^2 is a valve-seat, which is placed at the bottom of the recess into which the shaft, C, is screwed, and is kept down by that shaft when it is fixed in its place. In the centre of this valve-seat is a circular aperture, *f*, which communicates by four holes, *e*, *e*, *e*, *e*, with the concave segments, E, E, E, E. V is a ball-valve, which fits the circular aperture, *f*. As the concave segments, E, E, E, E, become filled with borings, which commonly takes place at each stroke of the borer, these borings are forced up through the holes, *e*, *e*, *e*, *e*, and their common outlet, *f*, into the hollow interior of the shaft, C, (the ball-valve, V, giving way before them, and being kept from rising too high by a small bar across the tube;) and the quantity forced up at each stroke is prevented from returning by the descent of the ball into its seat at the end of the stroke. On the shaft, C, becoming filled, the instrument is raised, in the manner to be presently explained, when it may be emptied either through the top aperture, F, or (which the inventor rather prefers) by passing an iron rod up through one of the under holes, *e*, and thereby lifting the ball-valve, V, when the contents of the hollow shaft will flow or run out. F is an aperture for the escape of the air expelled from the hollow shaft, C. G, G, G, G, are holes for the admission of air or water into the concave segments, E, in order to prevent any vacuum being accidentally formed there.

II. *The Working Machinery.*

Fig. 5 is a side elevation, and fig. 6 an end elevation of the machinery by which the borer is lowered and raised. AA is a framework of wood, by which the machinery is supported; B is the lifting-bar, which is attached at top by a moveable key, *c*, to a sliding cross head, C^1, which moves in grooves in the framework. Near to the bottom the bar B passes through a fixed cross head or guide, C^2. The moveable cross head determines, of course, the length to which the lifting-bar is to be raised up, and consequently the height the boring tool, (which is attached to it by the chain, D,) is allowed to fall at each stroke made by the machine. EE are buffers, composed of caoutchouc, or some other like elastic substance, which form stops to the further descent of the lifting-bar, and prevent any injurious effects being produced upon the framework by the ends of the cross head. F is a shaft, which has its bearings in the framework, and carries the fly-wheel G, the drum H, the wiper I, and the pulley K, all of which are securely keyed to it. By the pulley, K, and a belt carried over it from some prime mover, the shaft itself is put in motion. The chain, D, by which the borer is connected to the lifting-bar, B, requires to be somewhat longer than the depth the hole is to be bored; the part of the chain which is not in actual use being carried over the drum, H, and then attached to some convenient part of the framework. L is a lever having its bearings on the framework at M; this lever is connected at the one end by a link, N, to the upper end of the lifting-bar, B, and from its other end there are suspended weights, O, which form a counterbalance to the increasing weight of the chain as the hole proceeds in depth. When the machine is to be worked, the shaft is made to rotate in the direction of the arrow. Each revolution of the shaft causes the wiper, I, to come in contact with the friction-pulley, P, which is attached to the side of the lifting-bar, and thereby lifts up the lifting-bar, the chain, and the borer. The instant, however, the wiper quits its hold of the pulley, P, the lifting-bar, the chain, and the borer fall by their own gravity through the space they were raised up by the wiper; and thus the operation is carried on continuously.

When the borer is to be raised to the surface to be emptied of its contents, the chain is disconnected from the lifting-bar, the connection being formed by means of a claw, which takes hold of any one of the links of the chain. The lifting-bar is then raised up to its highest point, by means of the wiper. The lever, R, is now brought under the projecting pin, S, and by applying power to the lever, R, the lifting-bar is raised up until the pulley, P, is without the range of the action of the wiper, which is then held in that position by a pin, T, inserted into the framework above the outer end of the lever, R. The chain is then drawn tightly over the drum, H, and the shaft, F, put in motion, whereby the borer is speedily brought to the surface. The utmost length of fall given to the borer is determined by the length of the wiper, I; but a shorter stroke may be given at pleasure, by bringing the cross head, C^1, further down upon the lifting-bar, which is accomplished by means of the moveable key, C.

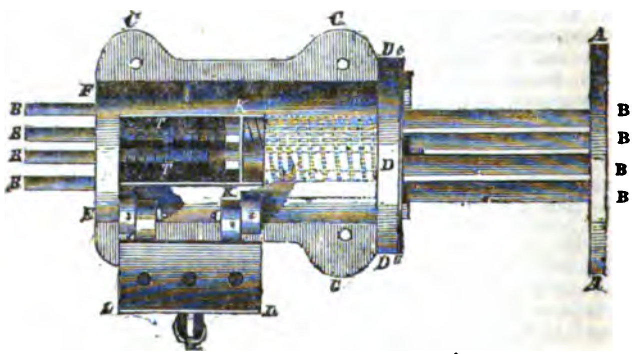
EXPERIMENTS ON THE FORCE OF THE WAVES OF THE ATLANTIC AND GERMAN OCEANS. BY THOMAS STEVENSON, ESQ., C.E.

[From the Report of the Harbour of Refuge Commissioners.]

In forming designs of marine works, the engineer has always a difficulty in estimating the force of the waves with which he has to contend. The information on such a matter, which is derived from local informants, who, although intelligent in the departments of trade which they follow, are, nevertheless, more or less prejudiced from being constantly on the spot, is not satisfactory; and it has, therefore, often occurred to me that it would be most desirable if the engineer could be enabled, to some extent at least, to disregard the prejudiced statements of others, and the vague impressions left by them on his own mind, and really to ascertain, by direct experiment, what force, expressed in pounds, per square foot, the sea actually exerts upon the shores where his buildings are proposed to be erected.

Notwithstanding the want of all direct experiments* on this subject, and the somewhat unpromising nature of such an inquiry, I was, nevertheless, induced to attempt the construction of an instrument to effect the desired end; and after several fruitless devices had been put to the test, I at length succeeded in forming one whose indications I hope to be able to show are trustworthy. Before considering the results obtained, however, I shall explain the construction of this simple self-registering instrument.

The letters DEFD represent a cast-iron cylinder, which is firmly bolted at the projecting flanges, CC, to the rock where the experiments are wanted. This cylinder has a flange at DD. LL is a door, which is opened when the observation is to be read off. AA is of iron, and forms a circular plate or disc, on which the sea impinges. Fastened to the disc are four guide-rods, BBBB. These rods pass through a circular plate, CC, (which is screwed down to the flange,



DD,) and also through holes in the bottom, EF. Within the cylinder there is attached to the plate, CC, a powerful steel spring, to the other or free end of which is fastened the small circular plate, KK, which again is secured to the guide-rods, BBBB. There are also rings of leather, TT, that slide on the guide-rods, and serve as indices for registering how far the rods are pushed through the holes in the bottom; or, in other words, how much the spring has been drawn out or lengthened by the force of the sea acting upon the plate or disc, AA. The object of having four leathern rings, where one might have answered the purpose, was merely that they might serve as a check upon each other; and so perfectly did they answer the purpose intended, that in every instance they were found equidistant from the bottom of the cylinder; proving thereby, that, after the recoil of the spring, they had all kept their places. The guide-rods are graduated, so as to enable the observer to note exactly the quantity that the spring has yielded.*

This instrument, which may, perhaps, be not improperly termed a Marine Dynamo-

* Sir S. Brown has indeed stated, that at Brighton he found the impetus of the waves during heavy gales was "equal to 80 lbs. to a foot upon a cylindrical column of 12 inches diameter." The hydrostatical pressure of a wave only 1½ foot high is equal to 80 lbs. upon a square foot.

* It has been suggested to me, that the indications of the instrument might be made through the medium of a flexible wire or chain at a considerable distance from the instrument, and thus the impulse of every wave might be observed.

meter, is, therefore, a self-registering apparatus which indicates the maximum force of the waves. In the graduation of the instrument, the power of the spring is ascertained by carefully loading the disc with weights, so that when the quantity that the spring has yielded by the action of the sea is known, the pressure due to the area of the disc exposed is known also. The discs employed were from 3 to 9 inches diameter, but generally 6 inches, and the powers of the springs varied from about 10 lbs. to about 50 lbs. for every $\frac{1}{8}$th inch of elongation. Their respective effects were afterwards reduced to a value per square foot. The instrument was generally placed so as to be immersed at about three-fourths tide, and in such situations as would afford a considerable depth of water. It is not desirable to have the instrument placed at a much lower level, as it has not unfrequently happened during a gale, that for days together no one could approach to read off the result and readjust the indices to zero. It must, however, at the same time be remarked, that it is in most situations almost impossible to receive the force unimpaired, as the waves are more or less broken by hidden rocks or shoal ground before they reach the instrument.

In connexion with the apparatus above described, a graduated pole was erected on an outlying sunken rock, for the purpose of ascertaining the height of the waves; but the observations were not of so satisfactory a nature as could have been desired, and the poles soon worked loose from their attachments, and disappeared.

With the instrument which has been explained, I entered upon the following train of observations:

In 1842, several observations were made on the waves of the Irish Sea at the island of Little Ross, lying off the Bay of Kirkcudbright. Since April, 1843, till now, continued observations have been made on the Atlantic at the Skerryvore and neighbouring rocks, lying off the island of Tyree, Argyllshire. And in 1844 a series of similar observations was begun on the German Ocean at the Bell Rock. It will be seen, that in selecting these localities a varied exposure has been embraced, comprising the comparatively sheltered Irish Sea, the more exposed eastern shore of Scotland, and the wild rocks of Skerryvore, which are open to the full fury of the Atlantic, the far distant shores of North America being the nearest land on the west.

Referring for more full information to the tables of experiments which accompany this paper, it will be sufficient in this place to state generally the following, as the results obtained:

In the Atlantic Ocean, according to the observations made at the Skerryvore rocks, the average of results for five of the summer months during the years 1843 and 1844, is 611 lbs. per square foot. The average results for six of the winter months (1843 and 1844), is 2,086 lbs. per square foot, or thrice as great as in the summer months.

The greatest result yet obtained at Skerryvore was during the heavy westerly gale of the 29th of March, 1845, when a pressure of 6,083 lbs. per square foot was registered. The next highest is 5,323 lbs.

In the German Ocean, according to the observations made at the Bell Rock, the greatest result yet obtained is 3,013 lbs. per square foot.

It thus appears, that the greatest effect of the sea, which has been observed, is that of the Atlantic at Skerryvore, which is nearly equal to three tons per square foot.

These experiments, amounting to 267 in number, and on the Atlantic alone extending over 23 months continuously, are not intended to prove anything further than the simple fact, that the sea has been known to exert a force equivalent to a pressure of three tons per square foot, however much more. Now, when we consider that the hydrostatic pressure due to a wave of 20 feet high is no more than about half a ton on a square foot, we see how much of their force the waves owe to their velocity. There can be no doubt, however, that results higher than this will be obtained. Were a train of observations made at various points of the coast, the result would not only be highly useful in practice, as they would by reference to existing marine works show what sizes of stones and proportions of piers were able to resist seas of a given force; but they would form an interesting collection of information with regard to the relative forces of the waves in our contracted bays and estuaries, as compared with those observed in the ocean; and would thus supply the want which, as already stated, all engineers labour under, to a greater or less degree, in designing marine works.

It is proper, however, to observe, that there may be some objection to referring the action of the sea to a statical value. Although the instrument might perhaps be made capable of giving a dynamical result, it was considered unnecessary, in these preliminary experiments, to do anything more than represent the maximum pressure registered by the spring, because the effects of the waves may, from supposing them to have continuity of action, be perhaps regarded as similar to a statical pressure, rather than to the impact of a hard body.*

* With reference to the continuous action of water, I may notice the effects produced by the

The near coincidence, or, indeed, almost perfect agreement of the results of the experiments made with different instruments, goes far to show that the waves act in very much the same manner as a pressure, although both pressure and impact must obviously enter into their effect. In the experiments, begun February, 1844, and given at the end of the paper, the three instruments had not only different areas of discs, but very different powers of springs, and yet the results were almost identical. Now, the same force, supposing the waves to act like the impact of a hard body, would in the marine dynamometer assume very different statical values, according to the spaces in which that force was expended or developed; so that with the same force of impact, the indication of a weak spring would be less than that of a stronger.

In future experiments it may be interesting, however, to test the springs dynamically, by means of the impact of a heavy body dropped from a given height upon the plate or disc of the instrument. In some experiments lately made in this way, by dropping a cannon-ball upon the disc, it appeared that, within the limits of the experiments, there was for each individual spring a ratio between the value registered by the leathern index and the calculated momentum of the impinging body. These ratios were, of course, found to vary in springs of different power, and to be constant only for springs of the same power. Did the waves, therefore, act by a sudden finite impact, like the cannon-ball employed in this instance, we could scarcely have found such harmony between the results of instruments with different springs as the experiments alluded to afford. At the same time, the result cannot, perhaps, be in strictness considered correct; but, from the elongation of the spring being very small, the results may be regarded as practically correct,—the more so when we find so remarkable a coincidence of results as that alluded to.

I shall now contrast the indications of the marine dynamometer by stating a few facts regarding the ascertained effect of the waves in the elevation of spray, and in the transportation of heavy masses of rock. This is more especially important, as to some, the results indicated by the instrument have appeared greater than they could have expected; and it has even been supposed that, were they correct, the stones which constitute our marine works would be scattered. Before passing from this point, it may be well to observe that the stones composing sea-works are not only wedged and compacted together, but they derive from the superincumbent courses (independently of the support afforded by the backing), a pressure so great as to cause an amount of friction which is, in most cases, greatly more than sufficient to preserve them in their places.

But to return to the facts of the ascertained effects of the waves, it may be interesting, in the first instance, to give some idea of what may be looked for in comparatively small expanses of water, such, for instance, as the lakes of North America, which, however, exhibit during gales of wind all the characteristics of an open sea. In the north-eastern corner of Lake Erie, the harbour of Buffalo was constructed at a cost of about £40,000. It is mentioned in the "Civil Engineering of North America," that the author "measured (at this harbour) several stones which had been moved; and one of the largest of them, weighing upwards of half a ton, had been completely turned over, and lay with its bed or lower side uppermost."

In the Firth of Forth, at the Granton Pier works, on 19th December, 1836, after a gale from the north-east, one stone was moved measuring 15 cubic feet, or about one ton in weight, and thrown on the beach, after having been built into the wall; and a stone containing 18 cubic feet was moved 30 feet from its place; while the *pierres perdues*, or mould-stones, were washed down to a slope of about 4 to 1.

The following instance, which occurred at the landing slip of the Calf Point, Isle of Man, affords a proof of the great force of the waves even in the Irish Sea. During a gale from the north-west a block was lifted from its place in the wall, and thrown landwards, which measured 123½ cubic feet, equal to about 10 tons weight.

In the German Ocean, we can refer to the Bell Rock Lighthouse,* which, though 112 feet in height, is literally buried in foam and spray to the very top, during ground swells,

failure of Beith's Dam, a reservoir situated upon the high grounds near Cartsdyke, immediately east of Greenock. This dam had a head of 20 feet of water, and gave way on the night of the 21st November 1835, when the water, after breaking down another reservoir below it, rushed through the streets of Cartsdyke, causing the melancholy loss of no fewer than 41 lives. This continuous flow of water carried away many houses; and, among other instances of its power, it is recorded that a "mass of rock, about 16 tons weight, was borne along by the torrent to a distance of 30 or 40 yards." This case, then, which almost equals the records of the fury of the sea, shows the effects which continuous action may produce.

* At such a situation as the Bell Rock, a column of water or of air could be conducted into the interior of the house, and might, in one case, show the force of each wave as it struck the building by the rise of the water column; or, in the other, by a pressure-gauge, show the same result in atmospheres by compression.

when there is no wind. It is, therefore, a very important station for making such experiments, because the rise of the spray may be regarded as a scale by which the results of the marine dynamometer can be checked or compared.

In the published account of this work there occurs the following statement:—On the 24th October, 1819, the spray rose to the height of 105 feet above the rock. "It may, perhaps, therefore," says the author, "be concluded, that the maximum force of the sea at the Bell Rock is to raise the sprays to the height of about 105 feet above the surface of the rock;" and deducting 16 feet, which is the height that the tide rises upon the tower, there is left 89 feet, as the height to which the water is raised. This is equivalent to a hydrostatic pressure of about 2½ tons on the square foot. Since that time, however, there have been still greater proofs of the force of elevation. On the 20th November, 1827, the spray rose 117 feet above the foundations or low-water mark; and the tide on that day rose 11 feet upon the tower, leaving 106 feet as the height of elevation (exclusive of the trough of the sea), being equivalent to a pressure of very nearly 3 tons per square foot.

At the island called Barrahead, one of the Hebrides, a remarkable example occurred during a storm in January, 1836, in the movement of a block of stone, which, from measurement taken on the spot, is 9 feet × 8 feet × 7 feet = 504 cubic feet, which, allowing 12 feet of this gneiss rock to the ton, will be about 42 tons weight. This great mass was gradually moved 5 feet from the place where it lay, having been rocked to and fro by the waves till a piece broke off, which, rolling down and jamming itself between the moving mass and the shelving rock on which it rested, immediately stopped the oscillatory motion, and thus prevented the further advance of the stone.

Mr. Reid, the principal keeper of Barrahead Lighthouse, the assistant keeper, and all the inhabitants of the little island, were eye-witnesses of this curious exhibition of the force of the waves; and Mr. Reid also gives the following description of the manner in which they acted upon the stone:

"The sea," he says, "when I saw it striking the stone, would wholly immerse or bury it out of sight, and the run extended up to the grass line above it, making a perpendicular rise of from 39 to 40 feet above the high-water level. On the incoming waves striking the stone, we could see this monstrous mass of upwards of 40 tons weight lean landwards, and the back run would uplift it again with a jerk, leaving it with very little water about it, when the next incoming wave made it recline again. We did not credit the former inhabitants of the island, who remarked that the sea would reach the storehouse which we were building; and when these stones were said to have been moved it was treated with no credit, and was declared by all the workmen at the lighthouse works to be impossible; yet the natives affirmed it to be so, and said if we were long here we might yet see it. They seemed to feel a kind of triumph when they called me to see it on the day of this great storm."

Having now detailed the various observations and facts of which I was possessed in relation to this subject, it may be necessary, in conclusion, to consider the general bearing of such an inquiry.

The advantages which may ultimately arise from a knowledge of the energies of the ocean can only be guessed at in the present state of our information. It is not to be expected that, in the present train of experiments, much will be found that is directly valuable in practice, as time is required before a true maximum result can be discovered. But a very close and promising connexion may easily be traced between the present inquiry and the principles of hydraulic architecture, as illustrated in the construction of breakwaters, sea-walls, lighthouses, and piers of timber or of stone, and in the calculations for the strength of the booms which are employed for excluding waves from the interior of harbours; also, in trying the power of waterfalls, and in contrasting the action of waves at the surface with that at the bottom, or at various depths along the sea slopes of breakwaters.

Theoretically, there is much also to invite to a prosecution of such observations. In connexion with researches so successfully prosecuted by Mr. Scott Russell in the mechanism of oceanic waves, their height, their velocity, and their distance apart, surely observations on the development of the gradually acquired force of such undulations, when they become waves of translation, will form a very important feature in marine mechanics. In the science of geology, the most direct bearing of the results of the marine dynamometer is on the subject of erratic boulders. It is no easy problem to account for the presence of enormous boulders which are foreigners to the formation where they lie, and often, also, far distant from the formation to which they belong. Accordingly, we find that glacial action has been suggested as the cause of transportation. Mr. Milne has suggested that a continuous rush of waters, due to volcanic emersion, might, at any rate, account for the distribution of the largest

erratic boulders which are to be found in Roxburghshire. The results of the marine dynamometer, and the facts above recorded of the action of different bodies of water, will certainly be admitted to go far in proof of the competency of aqueous action, to effect the distribution of the erratic blocks referred to by Mr. Milne.

ON THE PREVENTION OF SPONTANEOUS COMBUSTION ON BOARD SHIP, ETC.

Sir,—In the weekly number of your excellent miscellany, for March 18th last, appears an account of a means proposed by Mr. Bland, of Sydney, for preventing fire arising from spontaneous combustion, by a plentiful supply of carbonic acid gas. This plan is not without its advantages in case of fire, but it does not offer a good means of preventing the causes which give rise to such catastrophes. Some plan which can be in *daily* use, and act on the principle of prevention, is still a desideratum.

It may not be known to Mr. Bland, or your readers generally, that in the year 1802 a patent was taken out by Mr. Henry Gardiner, of Norwich, "for a method of preventing all sorts of corn and seeds, and various other merchandise, from receiving damage by heat on board ships and in warehouses." His invention consists in keeping the grain, or other cargo, cool, by an artificial draught, by means of air-pumps or ventilators. For ships he recommends "a ventilating bottom, formed of hollow perforated frames, which should lay a little above the keelson;" the holes averaging in number about nine to every square inch. He describes his method as applicable to ventilating the whole, or any one part of the cargo, more than another; and he observes: "If care be taken to work the air-pump regularly when the corn is first shipped, it will be the most effectual means to prevent damage, as any disposition to heat will be thereby speedily counteracted by the cool fresh air arising through the corn." He suggests that the "ventilating floors may be formed of wire, perforated iron, tin, or bricks," and he claims for adapting these for the purpose of ventilation. The use of his plan in granaries he states greatly improves stale and fusty corn, rendering it sweet and fit for use.

The mechanical arrangements, to carry the air by hollow perforated floors and pipes through the hold of a vessel, and provide for its escape on deck, require no particular description; but the following statement deserves notice. Speaking of the action of the air-pump, he says, "At every stroke of the piston, in a cargo of wheat, 1,000 quarters, containing 8,000 Winchester bushels, the interstices are about one-seventh, or 1,143 bushels; consequently, in working an air-pump whose cylinder contains only two Winchester bushels of air, fifty strokes in a minute, which may be done with great ease for four hours, the 1,143 bushes of confined air will be expelled, and 24,000 bushels of fresh air will be forced through the cargo."

I see no objections to combining Mr. Bland's with Mr. Gardiner's plan; and, if the latter fails in suppressing spontaneous combustion, the former will be rendered more efficient by the gas easily finding its way to every part of the cargo; and, indeed, the air-pump might be made to perform a reverse operation, by assisting to distribute this non-supporter of combustion. The subject is so interesting and so important, that every suggestion that can be offered to stop the terrors of a conflagration at sea, is deserving of the most serious attention of Government and of shipowners generally.—I am, Sir, yours, &c.,

INVESTIGATOR.

London, April, 1848.

NEW PROCESS FOR OBTAINING WHITE OUTLINES OF ANY KIND ON PAPER.

[From *La Presse.*]

Almost all salts are volatilized when their solutions are evaporated. The nitrate of silver enjoys this property to a high degree. Hitherto, the very curious results which the principle affords, and by which we are enabled to obtain all sorts of designs, have not been turned to account in the arts.

Project 500 or 600 grammes (a gramme is somewhat less than a scruple, or 20 grains,) of silver, say in crown pieces, into pure nitric acid at 40°, two parts, and distilled water one part. Heat the mixture so as to induce chemical action. Now, hold over the vapour a design placed on a sheet of white paper; then exposé to the light. The uncovered part of the paper will assume a dark hue; and on removing the design, the

latter will be found reproduced with the utmost fidelity: one may thus obtain 700 or 800 sheets of considerable dimensions. The theory of this process is obvious: the nitrate of silver carried up by the vapour becomes attached to the uncovered portions of the paper, and is afterwards coloured by the sunlight. The expense is next to nothing, since the greater portion of the silver remains behind, and may be either reduced, or disposed of in the form of nitrate of silver.

The author of this curious notice, whose name is not mentioned, thinks that this interesting process is calculated to produce great changes in the fabrication of stained papers.

[The description of the process does not seem altogether clear; and on the assumption set out with, the simple solution of nitrate of silver in *boiling water* should also suffice, supplying fresh water occasionally, and sustaining the heat to an almost unlimited extent.—*Trans.*]

EVANS'S PATENT RAILWAY WHEELS.'

[Patent dated October 28, 1847. Patentee, Mr. Edward Evans, of the Haigh Foundry Company. Specification enrolled April 28, 1848.]

Specification.

My invention consists of a new and improved mode of constructing iron wheels, by which the tire or hoop of the wheel is securely connected with the spokes, or with the inner rim and periphery, without the use of bolts or rivets. For this purpose I form a dovetail groove on the inner surface of the tire, as represented by the section, fig. 1, and dovetail projections on the spokes, as also shown in fig. 2. When an inner ring or periphery, to which the spokes are attached in the usual manner, is employed in the construction of wheels, I form such inner ring or periphery of iron rolled on one side with a dovetail projection, so that this iron when beat into a circle will have on its exterior portion a continuous dovetail projection, which may be fitted into the tire or hoop, as afterwards described; the spokes being attached to such inner ring and the nave according to any of the usual well-known methods. Or the inner ring may be formed of segments by bending iron with a dovetail projection, as described, into segments which are to be brought into close contact at their sides and fastened together, and into the nave by any of the usual methods. These segments will present an inner

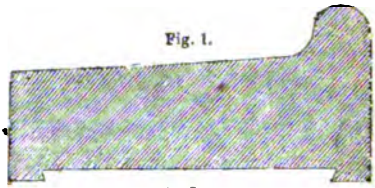


Fig. 1.

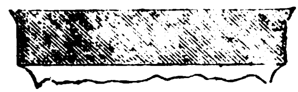
Fig. 2.


Fig. 3.



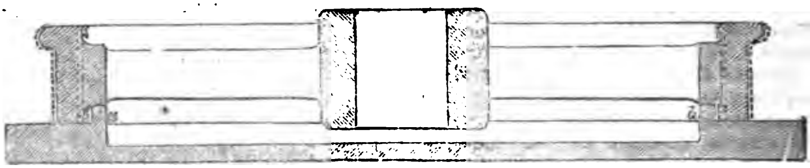
Fig. 5.


Fig. 6.


Fig. 7.

ring or periphery, having a number of dovetail projections on its outer surface. It will be seen, in figs. 1, 2, 4, 5, and 6,

Fig. 4.



that the dovetail groove in the tire is made wider at its *narrowest* part than the dovetail projection, as the spokes or inner rim is at its *widest* part, so that the latter will easily enter into the former when the tire is shrunk on. The dovetail projection will not fill the groove, but will leave a space which is to be filled up, as will be afterwards described and explained. The groove in the tire and the dovetail projections to be introduced into it, and the relative dimensions and sizes of the several parts, must be adjusted to each other according to the purposes for which the wheel is required, and so that the part which forms the side of the groove, or the inner surface of the tire or hoop of the wheel, may pass over the ends of the spokes, or the outside of the inner ring or periphery, when the tire is heated to be shrunk on, and that the bottom of the groove may come into close contact with the ends of the spokes, or the outer surface ring or periphery of the wheel, when the tire is contracted by cooling, or shrunk on, as is well understood in the manufacture of wheels. Fig. 4 is a section of a wheel and tire, and the plate on which they both are laid in a horizontal position, for the purpose of the tire being shrunk on; the dotted lines in the section of the tire will show its position when hot, and the full lines the position when it is cold. The plate on which they are laid may either have a rib cast on it, as at *a*, *b*, (fig. 4,) or it may be a plain plate, and small packings may be used instead of the rib; but the wheel, when fixed on the plate, must be raised by either the rib or the packing pieces, so that the groove in the tire, when put around the wheel, will be level with the rim of the wheel, and in such position that the one will easily enter the other, as the tire becomes contracted by cooling. When the wheel has been fixed on the plate, as shown in fig. 4, and the hoop or tire heated in a furnace, as is commonly practised in hooping wheels, the tire will have become expanded, and will pass over the wheel so as to encircle it. Now it will be evident that as the groove is rather wider at its narrowest part than the projecting dovetail is at its widest part, and the tire has contracted so as to bring the one within the other, there will be a space left on the sides, that is, between the sides of the groove and the sides of the projection, and the dovetails would in that state form no joint or security for holding the one to the other. In order, however, to make this a perfect joint, I then fill the spaces on the sides with melted metal or other hard substance, and for which purpose I prefer zinc, as being the hardest and cheapest of the easily melted metals. There would be a difficulty in getting the tire off the wheel for any purpose of repairs, if the metal were not of a kind to be easily melted. If it be thought desirable, the wheel may be shifted as the tire gradually cools, so as to bring one side of the dovetail projection in contact with the side of the groove, and thus leave only one side to be filled. I do not, however, think any advantage would arise in adopting this latter mode. Fig. 5 is a section of the rim of the wheel and tire, with both sides filled with the melted metal; and fig. 6 is a section with the wheel shifted to the side of the groove, and only one side filled with metal. The dark parts in both cases represent the metal which has been run in, and thus made to form the joint, so as to prevent the tire separating from the wheel. The rim of the wheel may be made of iron, rolled or forged into the required shape, or it may be turned to the proper shape in a lathe, and the dovetail groove in the tire may be formed in a lathe, or it may be formed in the manner following: The tire bar, which is intended to form the hoop of the wheel, must first be rolled into the shape as shown in section, by suitable grooves made in the rolls, as will be perfectly well understood; it must be then passed through a

groove in the rolls, of the ordinary shape for making tire bars, and the angular projections *a*, *b*, (fig. 7,) will be deflected towards each other, and will form a shape as shown in the section (fig. 7,) in dotted lines, and will thus make the groove in the tire sufficiently dovetailed, for the purpose of holding the tire and the wheel together, as already described.

These angular projections may also be depressed and thrown inwards by hammering while the bar is hot, and without going through the last groove in the roll. But I would observe that the forming dovetail grooves, or dovetail projections in or on pieces of metal, forms no part of the invention intended to be claimed by these letters patent, except in connection with the arrangements, and for the purposes herein described.

Having now described the nature of my invention, and in what manner the same is to be performed, I would have it understood that I do not claim as my invention the use of dovetail grooves or dovetail projections in the manufacture of wheels, many attempts having been made to render such fastenings practicably available in and for the manufacture of wheels; but what I do claim is the manufacture of wheels in which the dovetail groove in the tire is wider at its narrowest part than the dovetail projection on the spokes, or the inner rim of the wheel is at its widest part, and the filling the spaces left when the tire is shrunk on, with melted metal or other hard substance, as above described.

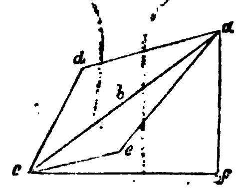
ON THE FLOW OF WATER IN OPEN CHANNELS. BY WM. DREDGE, ESQ., C.E.

(Concluded from page 250.)

Sir,—If these papers possess any interest to your readers, I ought to apologise for allowing so much time to elapse before resuming the subject.

In my last communication I observed that the velocity of a stream depended as much upon the curve as upon the general inclination of its surface. I illustrated these observations by diagrams, and entered into a few calculations to show their application. As some of your readers may not be sufficiently versed in mathematics to understand the formula upon which the calculations depend, I have drawn the following diagrams, to illustrate, by a comparative mechanical example, the truth of my observations.

Fig. 1.



Three balls starting from the point *a*, fig. 1, and rolling down the paths *a d c*, *a b c*, and *a e c*, would, theoretically speaking, arrive at *c* with the same velocity, and would be equal to the velocity of a fourth ball at *f*, after falling through the line *a f*. Practically, however, this is not the case, because of the variation of the loss from friction in the several paths taken by the balls. The one falling down the perpendicular, *a f*, would cut the horizontal line, *c f*, with the greatest velocity, and of the other paths, *a d c*, *a b c*, and *a e c*, that ball which rolls down *a d c*, would arrive at *c* with a greater velocity than either of the others; the next in rotation would be the next greatest, whilst that one which rolls along the path, *a e c*, would arrive at *c* with the least velocity.

These remarks apply with greater force to a fluid than to a solid body, and this shows that a general formula, to embrace every case, is impracticable.

I will now make a few remarks upon the effect of the *form* of the transverse section of the channel on the velocity of the current, confining my remarks particularly to the two forms of drains; for though there can be no doubt of the greater efficiency of the egg-shaped in comparison with the flat-bottomed drain, yet the opinions given by several gentlemen before the Sanitary Commission in favour of the latter, leads one to ponder well, the grounds upon which such opinions could be formed.

If Eytewlein's formula could indiscriminately be depended upon, the bottom of the sewer should invariably be broad and flat, or rather it should be a flat segment of a circle; but this is contrary to every day's experience. For with the same area of section *a b c d*, and *e f g h*, (figs. 2 and 3,) the wet contour, *a b c*, (fig. 2,) is generally less than the wet contour, *e f g*, (fig. 3,) and therefore,

Fig. 2.

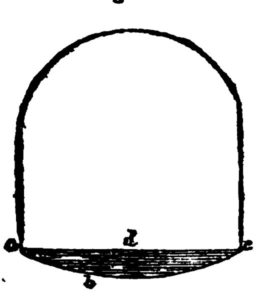
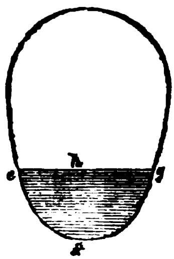


Fig. 3.



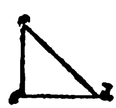
in applying the equation $V = 307 \sqrt{\frac{R}{S}}$ it would be found that the value of V would be greater in fig 2 than in fig 3. But experience shows that this is not the case, for the egg-shaped drain keeps well cleaned, and therefore the water flows more freely through it than in flat-bottomed drains, along the bottom of which deposit invariably accumulates.

The greater efficiency of the egg-shaped drain, appears to me to be in consequence of the superior statical pressure of the stream as it flows along the drain.

I stated in a previous paper (*see ante*, p. 208,) that a running stream was influenced by a dynamic force in the direction of its flow, and by a statical pressure upon its bed; and also that the statical pressure would, when encountering any impediment, be transferred into a dynamic force to accelerate the velocity of the stream. Therefore, if *b a*, and *e f*, (figs. 4 and 5,) represent respectively the

Fig. 4.

Fig. 5.



depth of the water in figs. 2 and 3, *a b c* and *d e f* will be the triangles whose area will represent the statical pressure due to those depths, which, so long as the stream continues uniform, is kept in equilibrium by equal resistances in every direction. If a deposit takes place, then an impediment to the stream occurs, and the statical equilibrium is disturbed, and a portion of it transformed into a dynamic force, which either sweeps away the impediment, or increases the velocity of the stream in passing it. Thus, if an impediment existed at the points *a* or *f*, figs. 4 and 5, the statical pressure that would be disturbed would be represented by the lines *a c* and *f d* respectively, and as *f d*, (fig. 5,) is a longer line than *a c*, (fig. 4,) it follows that water, of the depth, *f e*, will have a greater effect in scouring, than when the water is of a lesser depth.

The law which governs the flow of water through pipes is much more simple in its operation than that which regulates the discharge of water in open channels. Calculations of the velocity and quantity discharged in any given time may approximate with considerable accuracy; for the transverse section of a pipe is a regular figure, it is always full, and the material of which it is composed is of uniform texture; the friction is, therefore, invariable.

The stream through a pipe meets with no extraneous impediments—the data are fixed and invariable. The following are the only points which can affect the calculation, all of which can be ascertained with considerable accuracy:

1st. The height of head of water above the discharge.

2nd. The length and internal diameter of the pipe.

3rd. The friction upon each *unit* of pipe; and,

4th. The number and magnitude of the bends in the whole length of the pipe.

I have found the following equation, (which is, I believe, given by Langsdorf,) when modified, to approximate very nearly in practice—

$$v = \sqrt{\frac{548dh}{d + \frac{1}{48}l + \frac{1}{8}ds}}.$$

Where v is the velocity of the water; h, the height of the head; l, the length of the pipe; d, the diameter, and s, the sum of the squares of the sines of the several changes in the direction of the pipe; l b d and v, being all in English inches.

As these papers have greatly exceeded the limits I had at first assigned to them, I will now draw them to a close; but should I, in the course of investigations, arrive at anything of interest, I will ask permission to lay it before your readers.

I remain, yours, respectfully,

WILLIAM DREDGE.

CAPTAIN ERICSSON'S MARINE-ENGINE CONDENSER AND EVAPORATOR.

[*Report to the Secretary of the Treasury of the United States, by a Commission appointed to test an Apparatus invented by Captain Ericsson, for supplying the Boilers of Marine Steam Engines with a continuous Supply of Fresh Water. Republished from the "Franklin Journal."*]

New York, Oct. 31, 1847.

Sir,—In acceptance of your invitation of the 17th ultimo, we, the undersigned, had the honour to meet together in the city of New York, with the view of testing and reporting upon an apparatus invented by Captain John Ericsson, for the purpose of supplying the boilers of marine steam engines with a continuous supply of fresh water, and applied by him under your direction in the United States Revenue Steamer *Legaré*.

We have now respectfully to report, that on the 23rd ultimo we embarked in the *Legaré* at 12 M., proceeded to sea, and remained on board till the following morning. During this time the boiler was in operation 15 hours, and we had ample opportunity of examining the means employed for supplying it with water, and the results produced.

By the ordinary method of condensing steam in marine navigation, boilers are supplied with the *water of condensation*, composed of the steam that is withdrawn from the boiler and the necessary quantity of salt water required for its condensation. Hence, a boiler in operation is constantly parting with steam (fresh water) and receiving salt water in exchange. The effect of this operation, uninfluenced by a correction, would be, that in a few hours a degree of saturation of the water in the boiler would be reached, that would precipitate upon the plates of the furnaces and flues, a scale of sufficient thickness to arrest the passage of the heat to the surrounding water, and cause the destruction of the plates, by exposing them to a temperature destructive of their tenacity. The correction in use is the removal of the water as it approaches saturation, and is effected by *blowing* or *pumping off*.

In the operation of either of these methods, it is apparent that there is a loss of the heat that has been imparted to the water blown or pumped off, that neglect to open or shut the blow-off cock, or in the admission of the required supply of water, involves the duration of the boiler, and may, as it frequently does, involve the lives of the passengers and the crew, and the safety of the vessel. Even when all practicable attention is given to blowing-off, salt scale will be deposited in long voyages, particularly in the middle latitudes, and accumulate to an extent that renders its removal imperatively necessary. This is at all times a difficult, and, even under the most favourable circumstances, an imperfect operation, and when this deposit coats the surfaces of the flues, the consumption of fuel is increased to an extent unsuited to the economy of mercantile enterprise and to the duration of operation requisite for naval purposes.

This evil may be avoided by furnishing the boilers with a full supply of fresh water, and as the weight could not be accommodated, nor the space spared in a vessel for an instrument and its fuel for the sole purpose of distilling the quantity required, it is obvious that the steam furnished by a boiler must be returned to it, after being condensed by the radiation of its heat to cold surfaces, and not by the admixture of water. This method was *proposed* by James Watt, so early as the year 1776, and has been effected to some extent by an instrument invented by Mr. Samuel Hall, of England, and applied to the engines of many steam vessels, in some of which, notwithstanding its imperfections, it is yet used. It has failed, however, to answer the full purposes desired and anticipated.

In the arrangement of Mr. Hall, a great number of thin metal tubes, from one-half to three-fourths of an inch in diameter, were placed *vertically* in a condenser, and exposed to a current of cold water from the sea, and into which the steam from the cylinder was admitted, for the abstraction of its heat by the radiation of it to the water without the tubes. Now it is evident that by this arrangement, the condensed steam would run down the inner surface of the tubes, in its passage presenting a non-conducting lining to them, and in its collection at their bottom an obstacle to the current of the steam, and a diminution of the effective radiating surface.

With this method of condensation, it will be perceived that this instrument provides alone for returning to the boiler the water that has passed through the engine as steam. It follows, then, that all escapes of steam from the boiler or engine, or water-leaks from the boiler, pipes, &c., must be replaced by distillation, at an expense of fuel, directly as the evaporation. Further continued use of this instrument exhibited an oleaginous deposit upon the inner surface of the tubes, from the use of oil and tallow in the steam cylinder, and on the valve-faces, which, acting as a non-conductor, materially obstructed the condensation of the steam.

The apparatus of Captain Ericsson was

designed to obviate the difficulties and deficiencies developed in that of Mr. Hall, and is composed of two distinct instruments, a condenser and an evaporator; the first for the purpose of condensation, and the latter for a supply of fresh water to provide for any losses of steam or water from the boiler by escapes, leaks, gauge vents, &c., &c.

The condenser is a cylindrical vessel, set at a slight inclination from a horizontal line, containing the requisite extent of radiating surface in metal tubes of *two inches* bore, with an open space at each end. By this arrangement there is free space for the current of steam to pass, and for the condensed steam to run down the lower side of the tubes, without presenting a lining of water to intercept radiation, or an obstruction to the course of the steam. Connected with this is a pump, by which water from the sea is drawn in and forced through the spaces between the tubes and the inner surface of the shell of the condenser. Thus, the latent heat of the steam is absorbed by contact with the tubes, and condensation is effected for the double purpose of affording a vacuum for the engine and of restoring fresh water to the boiler, for continuous evaporation and condensation, to meet the requirements of the engine.

The evaporator, as constructed, is a parallelopipedon, with a semi-cylindrical top and bottom, the lower portion of which is occupied by a number of tubes similar to those in the condenser, which communicate with a valve at each end of the steam cylinder, worked by the engine: around these tubes, and for some distance above them, water from the sea is admitted, for the purpose of being evaporated; and the space above this water is open to the condenser, and, consequently, *in vacuo*. This instrument being designed to furnish fresh water to replace that which may be lost, its operation is resorted to only as occasion may require, and is effected in the following manner:—When the piston is near the termination of its stroke, the valve referred to opens (above or below, as the case may be,) and closes when the piston begins its return stroke; by this arrangement, steam is withdrawn from the engine that has very nearly performed its full expansive effect, and, passing into the tubes of the evaporator, its heat is absorbed by the water surrounding them, and as this water is *in vacuo*, it readily boils at a low temperature, and its vapour being led to the tubes in the condenser, it is condensed with the steam from the cylinder, and is supplied to the boiler.

Upon the experimental trial to which you were pleased to request our attention, all practicable arrangements for correct observations were entered into; and with a view to acquire full and progressive notes of the operations of the apparatus, the observations of the various points were confided to special committees, which, upon the conclusion of the trial, reported full notes for furnishing the following, viz.:

The boiler was filled with fresh water from above the opening of the blow off cock; below this, salt water had been left, from an impression of its effect being too inconsiderable to authorise its removal.

At the commencement of the operation of the engine, the water in the boiler, as indicated by a saline hydrometer, when at a temperature of 150° Fahrenheit, was $\cdot\frac{02}{32}$.*

The highest temperature of the *feed-water* observed was 158° Fahrenheit.

The lowest 132°, and the average 150°.

The highest *vacuum* observed was from 16 to 18 inches.

The lowest from 11 to 15, and the average was from 12 to 15 inches.

The highest *steam pressure* was 54 lbs. mercurial gauge.

The lowest was 20 lbs., and the average was 48·6 lbs.

The highest number of *revolutions* was 47 per minute.

The lowest number was 30, and the average 42·3.

The point of cutting-off was at three-eighths of the stroke.

The temperature of the sea water was 57.

Duration of *operation* of the engine and boiler 14 hours and 20 minutes.—Time during which steam was raised, 20 hours.

Dimensions of Engine, &c.

Cylinder.—36 inches in diameter, with a stroke of piston of 32 inches.

Boiler.—1,400 square feet of heating surface.

Condenser.—637 square feet of radiating surface.

Evaporator.—100 square feet of heating surface.

Upon coming to, the freshness of the water was again tested, and when at a temperature of 150° by a different thermometer than that used at the first operation, (it having been broken in the interim,) the hydrometer indicated $\cdot\frac{1\frac{1}{2}}{32}$; whether this difference in the indications is to be attributed to a change in the density of the water or to a difference in the thermometers, they being of different manufactures, we are unable to decide; fortunately the difference is quite inconsiderable, and is not regarded as deserving of further consideration.

* 12·32 being the point of saturation of water when at a temperature of 200°.

So soon as the temperature of the condenser was reduced to a degree that rendered an examination of it practicable, one of its heads was removed in our presence, and the tubes, when examined, were entirely free from any deposit or incrustation upon their surfaces, and the opinion is entertained, that at a temperature of feed water commensurate with economy of fuel, any difficulty from the deposit of oleaginous matter in this instrument is not to be apprehended.

Regarding the particular performances of the condenser and evaporator, it appeared that Captain Ericsson had relied too confidently on a general current of the cold water through the former instrument, whereas the current was quite partial, being but directly through its narrowest part, the sides of it: hence, the upper portion of it was almost inoperative—this feature was clearly developed by the application of a hand along the surface—while the effect of it was apparent in the moderate condensation indicated by an attached mercurial gauge.

Of the evaporator, its capacity was clearly shown, in the facility with which the level of the water in the boiler could be raised through the space between two gauge cocks, and by a resort to its operation not being necessary for more than one-tenth of the time.

Immediately after the close of this trial, measures were taken to effect a diffused operation of the cold water, and as diaphragms could not be introduced between the tubes to alter the current of the water, without incurring an impracticable delay, the expedient of causing the steam to circulate through the tubes was resorted to and was effected by the application of diaphragms in the open space at each end of the tubes. Upon the completion of this, a further trial was had on Friday, the 1st inst., when several observations furnished the following:

Pressure of steam,	50 lbs. mercurial gauge.
Revolutions	47 per minute.
Vacuum	20·5 inches.
Temperature of feed water....	150° Fahrenheit.
Do. of sea water..	62° "

Compared with the ordinary method of condensation, the value of the method observed is determined by an investigation and consideration of the following points, viz., evaporation, pressures, consumption of fuel, safety and duration of the boiler.

1.—Evaporation. *Ordinary Method.*

Temperature of Feed Water, 100° *Fahrenheit.*

Temperature of sensible and latent heats of steam..............	1192°
Deduct temperature of feed water..	100°
Heat to be added	1092°

New Method.

Temperature of Feed Water, 150° *Fahrenheit.*

Temperature of sensible and latent heats......................	1192
Deduct temperature of feed water..	150°
Heat to be added............	1042°

Then $\frac{1042}{1092} = \frac{\cdot 954}{1\cdot 00}$ which represents a gain in the evaporating temperature in the new method of 4·56 per cent.

2.—Pressures. *Ordinary Method.*

	Lbs.
Pressure of steam — mercurial gauge	50
Vacuum, 28 inches............	= 13·7
	63·7

Cut off at three-eighths of the stroke.

Effective pressure on the piston = 47 lbs.

New Method.

Pressure of steam	50 lbs.
Vacuum, 20·5 inches	= 10 lbs.
	60 lbs.
Effective pressure on the piston..	44·5 lbs.

Then $\frac{47}{44\cdot 5} = \frac{1\cdot 05}{1\cdot 00}$ which represents a loss in pressure by the new method of 5 per cent.

3.—Consumption of Fuel. *Ordinary Method.*

In the Gulf of Mexico and between the tropics it is necessary to blow off, when an hydrometer constructed similar to the one already referred to indicates $\frac{2}{32}$; in the Northern and Southern Atlantic and Pacific Oceans, when it indicates $\frac{2\cdot 5}{32\cdot}$. Hence $\frac{2\cdot + 2\cdot 5}{2} = 2\cdot 25$, the average point for blowing off.

As the average degree of saturation of feed water is $\frac{\cdot 75}{32}$, the quantity of water blown off compared to that fed to a boiler is as ·75 to 2·25, which is in the proportion of 1 to 3.

Temperature of the water blown off at the pressure and degree of saturation given	290°
Deduct temperature of feed water ..	100°
Temperature lost by blowing off	190°

As the heat to be added for the purpose of evaporation is 1092 $-1092 \times 3 - 1$, the proportion of feed water evaporated =	2184
And $190 \times 3 - 2$ the proportion of feed water blown off	190°
The heat absorbed is	2374°

Then $\frac{190}{2374} = \frac{\cdot 08}{1 \cdot 00}$ which represents the loss of heat by blowing off in the ordinary method of 8 per cent.

Summary of Results.

Gain by evaporation	4·56	per cent.
Do. by consumption of fuel,	8·00	,,
	12·56	,,
Loss by pressure	5·00	,,
Total............	7·56	,,

Which is a saving in the expenditure of heat, affording a like economy in the consumption of fuel, and altogether independent of the loss of heat, by the presence of a scale in the boiler, when salt water is used, and from leaks incurred by the oxidising effects of salt water.

With the *Ordinary Method*, the level of the water in a boiler is constantly varying from one or both of the following causes, viz., the quantity of the water blown off, or the particular extent of opening of the feed valve; while the effective operation of the feed pump and neglect of the blow-off valve involves the burning, or an explosion of the boiler.

With the *New Method* these operations are set aside, thus, blowing-off is unnecessary, and the supply to the boiler being first obtained from it, the transit being immediate and the communication incapable of restriction, (for if the condensed water was not taken off by the feed pump, the condenser would choke and become inoperative,) there can be no decrease in the level of the water, other than that arising from leaks of water and steam. Further, the use of fresh water in a boiler will extend the term of its duration from three and five years to seven and nine.

With a further modification of the condenser, establishing a more diffused current of the cold water, it is evident that a full vacuum may be obtained, as the practicability of attaining this end by external condensation has long since been developed, and with a less proportion of radiating surface than is exposed in the instrument referred to. From the analysis, however, here given regarding pressures and temperatures, it would appear that a full vacuum, with corresponding reduction of the temperature of the feed water, is not authorized; and as such departure from the hitherto practice furnishes the temperature necessary to prevent any oleaginous deposit upon the surface of the tubes of the condenser, practice and utility are in desired harmony.

A very effective and economical element in steam navigation arises with the operation of this new method, from the absence of scale in the boiler, the presence of which is unavoidable where salt water is used, and to avoid the formation of it as far as practicable, other than a low temperature and corresponding pressure are precluded by the waste of fuel and injury to the boiler consequent upon the existence of this scale, acting as a new conductor of the heat to the water—whereas, with the use of fresh water, higher pressures can be worked, and economy of fuel attained in an increased expansion of the steam.

Reviewing the facts herein presented, we are of the opinion that the operation of the apparatus of Captain Ericsson, as far as developed, was eminently successful, and that, with the modification of the condenser suggested, a higher degree of vacuum can be readily obtained. In view of the very great importance of the successful introduction of this method of condensation in the merchant and naval services, we recommend to your consideration the propriety of sending the *Legaré* on a distant cruise, *for the* purpose of developing the advantages of the apparatus by continued and extended use.

Apprised of the ready attention you have given to this important subject, and the zealous interest you have manifested in its development, we cannot but congratulate ourselves, and the profession with which we are connected, that you have seen fit to test this improvement by the construction of the apparatus on which we have been called to report. Such encouragement identifies in the merits of success the patron with the improvement, and is honourable to yourself no less than the nation in whose service you have bestowed it.

We have the honour to be, very respectfully,
Your obedient servants,

CHAS. H. HASWELL, *Engineer-in Chief*, U. S. N.
JAS. J. MAPES, *New York*.
LEWIS TAWS, *Philadelphia*.
JAMES MCFARLAN, *Union Ferry Co.*, N. Y.
J. H. TOWER, *Philadelphia*.
WM. SEWELL, SR., WM. W. W. WOOD, *Chief Engineers*, U. S. N.

To the Hon. ROBT. J. WALKER,
Sec. Treas., U. S.,
Washington, D. C.

PREVENTION OF PRIMING.

Dear Sir,—Having been a constant subscriber to your valuable Magazine for some years, I beg to offer a few remarks on an article I read in your Magazine, "On the Prevention of Priming in Steam Boilers," on the 29th ult., by Mr. W. Scotten, engineer, R. N., in which he proposes to use oily or fatty substances for the prevention of priming.

It is a well-known fact that oil, or tallow, or any fatty substance, is a great preventive of priming in ordinary steam boilers, but for locomotive boilers the case is quite the reverse. For instance, when a new engine is placed on a line, it is continually priming until the boiler is well washed and cleansed; locomotive boilers all being tubular, and having very little steam room, the space allowed is necessarily very small. Another disadvantage attending the use of oily matters is, their tendency to cause the impurities held in solution in the water to be deposited on the lower plates of the boiler, in contact with the fire.

As a proof of the above facts, I beg to state that I fixed a high-pressure engine, of 10-horse power, at the London-bridge Railway Station, about six years ago; but the steam from the exhaust-pipe proving an annoyance on the line, and there being a water-tank over the engine, containing 18,000 gallons, I proposed, and was authorised to fix, a coil of 4-inch pipe at the bottom, which effectually condensed the whole of the steam. In a few weeks after, however, we were nearly causing an explosion by returning the condensed water back to the boiler, in consequence of the oily matter combining with the water from the steam cylinder.

We were greatly surprised one day, while the engine was at full work—the steam being at that time at a pressure of 50 lbs. on the square inch—to hear a loud hissing noise in the furnace. On opening the fire-door, we saw that a row of rivets, five feet long, had given way, and that the water was coming out with enormous force. We instantly put out the fire, and on the following morning I went into the boiler, to ascertain the cause of so unusual an accident—the boiler being provided with a gauge-glass and two gauge-cocks, and the water at the time having been rather higher in the glass and fuller at the cocks than usual. On entering the boiler, I found a mass of sediment over the whole of the rivets which had given way, about three inches thick, which prevented the water coming in contact with the plate of the boiler, and thereby caused the rivets to become red hot, and a consequent expansion of the sediment, which allowed the water to come suddenly in contact with the rivets and plate of the boiler.

We examined the sediment taken out, in various ways, and found it to contain at least 50 per cent. of oily matter. The water used was Thames water.

Since that time—that is to say, for the last five years—we have used, as a preventive against a similar occurrence, a small quantity of common soda, which, combining with the oil or tallow, causes the whole of the earthy matter held in solution, to float on the surface of the water; and, by means of a blow-off pipe placed on the surface of the water in the boiler, the whole of the sediment is removed. The consequence has been, that we have not had the least occasion to clean the interior of the boiler, the plates and rivets remaining as clean as when first manufactured.

I am, Sir, yours, &c.,

JOHN HARRIS, Engineer.

London-bridge Railway Station, May 2, 1848.

MR. CRADDOCK'S PATENT STEAM BOILER AND CONDENSER.

At the last Quarterly Meeting of the Institution of Mechanical Engineers, held at Birmingham on the 20th ult., the merits of Mr. Craddock's patent steam boiler and condenser formed a prominent subject of discussion. The subject was opened by the reading of a paper by Mr. Craddock, which summed up the advantages attending his plans to be as follows:

An increased extent of grate surface; a slow state of combustion; great extent of heating surface for the fire to act upon; increased facility for generating the quantity of steam required; water free from deposit for the use of the boiler; removal of the atmosphere from the exhaust side of the piston; safety from explosion; great facility for generating the steam under higher pressure, by which the expansive principle is much extended; diminished tendency to priming; an effectual means of preventing the loss arising from steam blowing away at the safety-valve; self-adjusting means for keeping the steam at an uniform pressure, whatever the pressure desired may be; a continuous supply of pure water for the use of the boiler,—a fresh supply of not more than one gallon per horse power per day

being required to make good the loss by leakage; the engines and boilers brought into a much less space, and reduced to half the weight, for equal power, of those in common use.

(For the constructive details of Mr. Craddock's inventions, see *Mech. Mag.*, vol. xlvii. pp. 97, *et seq.*)

Mr. McConnell doubted the applicability of Mr. Craddock's boiler and condenser to railway locomotives, on account of the space they must occupy; but thought that they would be found most valuable for marine purposes.

Mr. Craddock stated that, according to calculations which he had made with great care, there would be a saving of not less than two millions sterling per annum effected by their adoption in our steam navy.

A discussion followed respecting the double cylinder engine, which is another of Mr. Craddock's inventions. (See *Mech. Mag.*, vol. xlvii., p. 121.)

Mr. Crampton stated that, in his opinion, the only advantage which the double cylinder engine possessed over the single one was greater steadiness of motion; but this did not compensate for the loss of power which he considered arose from the use of two cylinders, and the steam passing from the one piston to the other. Some time ago he had made some elaborate experiments upon the subject, and his conclusions then were that the loss amounted to 14 per cent.

Mr. Craddock admitted that there was a loss in the expansion which took place between the two pistons, but called Mr. Crampton's attention to the great irregularity of motion that would result from carrying the expansive principle to a great extent in one cylinder. He had worked his double cylinder engine up to its speed with the steam cut off at $\frac{1}{30}$ of the stroke.

Mr. Crampton observed that the steam would lose all its power before expanding to such an extent.

Mr. Craddock was ready to prove the fact experimentally at his works. He wished further to remind the meeting that, from his own experiments, he was convinced that by admitting high-pressure steam directly from the boiler into one cylinder, much of it was condensed by the comparatively cold metal of such cylinder; and that the water resulting therefrom, being in contact with the metal of the cylinder, did, when placed in communication with the condenser, again assume the form of steam; thereby uselessly carrying much heat from the boiler to the condenser without producing any mechanical effect.

IGNITION OF SPONGY PLATINUM.

Sir,—In the volume on Chemistry in "Lardner's Cabinet Encyclopædia," it is said that, by directing a small stream of hydrogen gas on spongy platinum, it becomes incandescent, and that the cause of this effect is not known. It seems to me surprising that the able writer did not know the cause of this phenomenon, as it can be explained in a way of extreme simplicity. The cause is this:—When the stream of hydrogen gas is directed on the sponge, it becomes combined with the oxygen of the air, and the caloric which existed in the two gases in a latent state, is now liberated in a sufficient quantity to make the sponge red hot. It will, no doubt, be asked, whether, supposing the hydrogen to be combined with the oxygen, water ought not to be produced? I answer, that water is produced; but experiments are generally tried in small wire baskets, so that the heat converts the water into vapour; but if the experiment is tried on a good conductor of heat, such as iron, a considerable quantity of water will be found after the experiment.—I am, Sir, yours, &c.,

C. BENTLEY.

GUTTA PERCHA PATENTS.—NO. X.

THOMAS FORSTER, *of Streatham, for "Improvements in Combining Gutta Percha with certain Materials, and in the Application thereof to Waterproofing Fabrics, and in the Moulding various articles therefrom; in Finishing the Surface of Articles made from Gutta Percha, or Gutta Percha combined with other Materials; and in Cleansing Gutta Percha."* Patent dated Oct. 21, 1847; Specification enrolled April 21, 1848.*

The first claim made under this patent is "for combining gutta percha with animal charcoal, ground whalebone, hydrate of sulphur, fragrant essential oils, musk, tonquin beans, orris root, or gum benzoin, and for applying them alone and in combination with caoutchouc, or other matters, to *fabrics*."

Charcoal, bone dust, milk of sulphur, and essential oil, have all been before proposed as matters fit to be combined with gutta percha; but not *animal* charcoal (*so nomine*), not *whale*-bone dust—not *fragrant* essential oils; and it is not every one who may know that "hydrate of sulphur" and

---

* We give the substance of this specification for the sake of keeping up our series of the Gutta Percha Patents; but there is nothing evidently new or useful in it. The most novel suggestion which it contains is the application of gutta percha to "smells." This is a sort of thing, which the patentee seems to understand well.

milk of sulphur are one and the same thing. So, therefore, Mr. Forster hopes to escape all suspicion of poaching on another's manor!

The proportions in which Mr. Forster recommends the materials to be combined are the following:

Gutta percha	4	parts.
Animal charcoal	1	"
or		
Gutta percha	4	"
India rubber..........	2	"
Animal charcoal	2	"

"When these matters are thoroughly combined, a portion of any solvent is to be added in such proportions as are needful for the particular fabric to be coated." And "when in a fit state to be spread on fabrics" he adds, if *required*, "orris root, or other perfumes, in such proportions as are necessary to give the goods the *desired* scent."

The patentee's second and third claims are:

"For combining gutta percha with ground bones, horns, hoofs, whalbone, or shavings of these matters, or animal charcoal, hydrate of sulphur, and applying the same alone, or in conjunction with *fabrics or veneers of wood* to the manufacture of various articles."

And "for uniting with gutta percha fabrics previously rendered repellants of water."

The principal parts of the specification bearing on these claims are the following:

"For coarse goods, such as carriage-covers, &c., I take gutta percha four parts, ground whalebone and hydrate of sulphur, each one part, and one-sixteenth part of any mineral preservation of vegetable matter—by preference, arsenic—and work the whole in a masticating pan, and afterwards spread it upon the fabrics, with or without a solvent. If the fabrics are required to be of any particular colour, I add to any of the above compositions the colour necessary to produce it. It is most convenient in coating thin fabrics, first to coat them with a solution of India-rubber, by any of the usual modes, giving them two or more coats, and when dry, applying the gutta percha. This plan prevents the latter staining the surface.

"When the fabrics are to be combined, or for moulding, I coat them with a compound of gutta percha three parts, animal charcoal one part, and one-sixteenth part of white arsenic, or other mineral preservatives of vegetable matters, and a solvent, as before, if necessary; or I use gutta percha four parts, Cornish white one part, and hydrate of sulphur one part, the whole combined, as before, in a masticating pan, after which is to be added the solvent. With these compositions I coat woven or felted fabrics, paper, and leather, or veneers of common wood, as scale-board, and afterwards combine several of them together, according to the thickness required; and when combined, I heat them, and bend or press them upon blocks into several useful articles, as portmanteaus, boxes, trays, cornices, frames, buttons, toys, and boards for book-covers. For such articles as are required to be embossed, I put a thick coating of the composition outside, in proportion to the impress required upon it.

"And I make the single fabric hot, and form it in the mould, either by pressing into or upon it, first laying on one coat and then another, until the article is as thick as required. The articles I thus form are masks, toy figures, tea and other trays, ink-stands, services and flowers, pill and other boxes, and such articles as are usually made of papier-mâché, toys, &c., and buckets, hats, caps, &c.

"In forming such articles as are required to stand wet, as buttons, tea-trays, military ornaments, &c., I first saturate the fabrics with any water-repellant matter—by preference, boiled linseed oil—and dry them thoroughly in a stove, and then coat them with the composition of gutta percha, and proceed as before described.

"In making panels for carriages, doors, boxes, &c., I use staves of wood, deal as the cheapest, and coat them with any of these compositions of gutta percha, using one part of them to two parts solvent. When the solvent has thoroughly dried, I take pieces of the required size, and heat them, and lay one upon the other, taking care to reverse the grain of the wood by laying the straight way of the one the cross way of the other; and if they are required to be very tough, I lay also a coarse canvas at back, or I use alternate layers of fabrics and wood, and then press the whole while hot, and keep the pressure upon them until cold.

"The compositions I prefer for moulding without fabrics are, gutta percha four parts, bone charcoal two parts, and one-sixteenth part of white arsenic.

"Or, gutta percha four parts, ground whalebone, or the rasping of horns and hoofs (from button-makers' waste) two parts.

"If I require a hard composition of a light colour, I use gutta percha three parts, ivory or bone dust one part, and Cornish clay a half part. A large quantity of animal charcoal or bone dust will make these compositions much harder at the expense of their toughness.

"In moulding from moulds that are very deep, I use cores of wood roughly shaped to the deep portions of the mould, first coating them with any of these compositions, viz., one part of them to two parts solvent, dry-

ing them in a temperature of ninety, and then covering them with any of the compositions without solvents, and pressing them into moulds until cold; the object being to make the gutta percha available for the figure and the minutiæ of the work, while the bulk, being wood, it will be lighter and much cheaper—which is essential, the price being high, and still increasing.

"I also roll, mould, or press either of the above compositions into sheets or bands, with the addition of colour, or perfumes, or both.

"The articles I make from these solid compositions, viz., without fabrics, are carriage and other wheels.

"Ornamental leaves and scrolls for furniture, military and other ornaments for harness, trays, frames, cornices, leaves, and flowers.

"When the articles are to be painted with light grounds, the composition containing the hydrate of sulphur should not be used, or such colours employed as are not likely to be acted upon by it.

"The quantity of perfumes to be used in any of these compositions must depend upon the purity of the material used for that purpose. I find, however, that of orris root, half a pound to every five pounds of the composition is necessary; of benzoin, two ounces to every five pounds; of the essential oils, half an ounce to five pounds is about the proportion."

Mr. Forster claims, fourthly, the following mode of finishing the surfaces of fabrics combined with gutta percha, which the reader may compare at his leisure with Mr. Hancock's mode of japanning such articles described at page 163, vol. xlvii.

"My mode of doing this is as follows:—Suppose the fabric is coated with gutta percha and animal charcoal or lamp black, the colour would be a dull black; to improve upon this plan, I take 10 lbs. of linseed oil, and 20 ozs. Prussian blue, grind it and mix them, boil the whole gentle until it is as thick as treacle, which is readily seen by trying a drop on a bit of glass, which will speedily cool and show its consistence. When cold it will be found to be a brown transparent varnish. Apply a thin coat to the surface of the cloth; it will be dry in a few hours, and in drying will absorb oxygen and become blue, thus giving the cloth the fine colour of black enamelled leather.

"If other colours are required, say red, the fabric should be coated with gutta percha and vermillion. Take one pound of any oil, varnish, or pale linseed, nut, or poppy oils, previously made, drying by any of the ordinary methods, and three ounces of crimson lake; well grind them together and coat the fabric with a thin layer of it. If the fabric has been embossed or corked to imitate suitable morocco leather, they will not be bad imitations of that article; of course any colour may be made upon this plan, suitable glazing colours being chosen, and such may be obtained from any artists' colourman."

GUTTA PERCHA PATENTS.—NO. XI.

THOMAS HANCOCK, *of Stoke Newington, Middlesex, Esq., for "Improvements in Fabrics Elasticated by Gutta Percha, or any of the varieties of Caoutchouc."* Patent dated Nov. 2, 1847; Specification enrolled May 2, 1848.

The patentee remarks that, in coloured woven fabrics which have been elasticated, or partly composed of gutta percha, "or any of the other varieties of caoutchouc,"* the colouring of the fibrous materials, whether silk, cotton, &c., has been effected previous to their being woven into cloth, &c., and that the weaving of these coloured threads into figures and patterns has been performed by looms of an expensive kind. Now, his improvements consist in making the operations of producing the coloured patterns a subsequent process to the weaving; that is to say, in imprinting the pattern or figures upon the woven materials by means of blocks, rollers, &c., as they are employed generally in the printing of patterns upon silk, cotton, and other cloths. Sometimes he prints the pattern upon the cloths, &c., while in an unextended state. When, however, the cloth, &c., is used in an extended state, as in making of braces, then he prints the figures thereon, while extended to that degree of tension which it is generally supposed to be in when used, so that the pattern may be exhibited in the most advantageous manner.

DUNN'S IMPROVEMENTS IN RAILWAY CARRIAGES.

[Patent dated Nov. 2, 1847. Patentee, Thomas Dunn, of the Windsor-bridge Iron Works, Manchseter. Specification enrolled May 2, 1848.]

The patentee first describes several improvements in the construction of railway wheels. One of the principal objects aimed at by him is the easy removal and replacement of the tire upon the wheel when it has become worn; this he effects in several ways,

* A degree of identity is here insinuated between the gutta percha and caoutchouc, which has no existence in fact, and which, considering Mr. Thomas Hancock's well-known connection with the caoutchouc manufacture, might well have been spared. For the peculiar and distinctive properties of gutta percha, see the specification of No. I. of our series, vol. xliv. p. 222.—ED. M. M.

although they are all pretty much on the same principle. His first method consists in having the nave, arms, and an inner tire cast in one piece, upon which the outer tire is bolted by means of a flange, which projects inwards a few inches beyond the inner surface of the tire. The joint between these two pieces, out of which the wheel is formed, is packed with gutta percha or some other elastic substance. A second method consists in having the nave of the wheel cast with mortices in it for the reception of wooden arms or spokes, and in afterwards fixing the tire to the nave, by bolts passing down through the middle of the spokes. According to a third method, that part of the wheel which is occupied by the arms is entirely filled in with segments of wood, between which segments there are driven wedges of either wood or iron, so that the wheel is almost entirely solid. The tire is attached to the nave by bolts, as in the former instance.

The patentee makes his axles of wood and iron, the wood forming an internal solid core, with an outer covering of iron. He also makes axles of several pieces, by having the naves truly bored out, and driving into them a short axle, or rather part of an axle, which is formed on the outside of the wheel, into the journal or bearing, and on the inside projects only a few inches, leaving sufficient strength of material to pass a cotter through to retain the axle in the nave. The two wheels forming the pair are then connected by rods of iron, (the patentee prefers using three such rods,) which have collars formed upon them near to their ends. The portions beyond the collars are passed through holes formed in the naves of the wheels, and have screws upon their outer ends, so that the wheels are, in a measure, devoid of axles—the connection between them being formed by the rods.

The second portion of Mr. Dunn's improvements relate to the construction of jacks for moving carriages and locomotives on to the line of rails when they happen to have got off the same. The chief feature of this improvement consists in providing the jacks with four small friction-rollers at the bottom of the pillar, by which the jack, with its load, is easily made to run upon a smooth surface in any direction.

A third improvement consists of a means of removing carriages from one line of railway to another, which Mr. Dunn effects by means of a low truck, running upon a set of cross rails. A portion of the main lines of rails is made to form an inclined plane at pleasure, by means of cams fixed under the rails, whereby he is enabled to run the carriages on to the low truck.

MR. SIMS'S "HYDRAULIC SUBSTITUTE FOR FLAT RODS."

Sir,—I was rather surprised to see in your Journal for the month of March, a communication from Mr. Sims, of Redruth, describing an hydraulic substitute for flat rods in mining machinery, seeing that the same idea is briefly described in your own Journal, vol. xliv., p. 387, where it is proposed to be applied to the man-lifting engine, for which a prize was given by the Royal Cornwall Polytechnic Society. I doubt not that your impartiality in inserting this will lead to such an explanation as will be perfectly satisfactory.—I am, Sir, &c.,

April 29, 1848. FAIRPLAY.

[Mr. Sims, who is one of the most candid men in the world, and has less occasion than most people to borrow from others, has himself already apprised us, that shortly after the publication of the contrivance referred to, he found out that it had been previously in use within twenty miles of his own residence, without his being at all aware of it.—ED. M. M.]

THE ELECTRIC LIGHT.

On Thursday night we had an opportunity of witnessing another exhibition of Mr. Staite's electric light, at the Bazaar, Baker-street. Certainly, the light produced was most splendid, both as to quantity and to quality. Although the light itself was no larger than about the size of a common pea, we could distinctly read small print (similar to the type in which this is printed) at the farther end of the coach gallery—a distance of about 130 feet from the light. Coloured objects, such as flowers, ribbonds, &c., appeared as distinct as they would by light of day; even the yellows were as distinct as if viewed by the light of the sun. The apparatus was fully described in No. 1275 of the *Mech. Mag.*

INQUIRIES AND ANSWERS TO INQUIRIES.

Railways.—"O. T."—The first railway or tramway on which a steam engine was employed for locomotive purposes was the Merthyr tramway, in the year 1805. The engine was built by Trevitheck and Vivian, and at the first trial drew a train of wagons, containing ten tons of iron and a considerable number of persons, at the rate of five miles an hour.

Electric Telegraph Wire.—"E. Chatterton."—The best method of covering wire for galvanic and other purposes is the patented process of Mr. W. Reed, which is described at page 432 of vol. xlvi., and is, we believe, that adopted by the Electric Telegraph Company.

WEEKLY LIST OF NEW ENGLISH PATENTS.

William John Normanville, of Park Village, Middlesex, gentleman, for certain improvements in railway or other carriages, partly consisting of new modes of constructing the axle-boxes and journals of wheels, also an improved method of lubricating the said journals or other portions of machinery, by the introduction of aqueous, alkaline, oleaginous, or saponaceous solutions. May 2; six months.

Isaac Hartes, of Rosedale Abbey, York, farmer, for certain improvements in machines or machinery for rowing, sowing, and manuring land. May 2; six months.

Isaiah Davies, of Birmingham, engineer, for improvements in steam engines and locomotive carriages, parts of which are also applicable to other motive machinery. May 2; six months.

Alexander Southwood Stocker, of York-place, City-road, for certain improvements in time-teachers and boxes, show-cards, or holders for matches, pens, pins, needles, and other articles, and in the mode or modes of manufacturing the same. May 4; six months.

Felicité Raison Selligue, of 6, Boulevart, Beaumarchais, Paris, widow, for certain improvements in propelling, and the machinery employed therein. (Being a communication from her late husband.) May 4; six months.

Henry William Schwartz, of Great St. Helen's, London, merchant, for improvements in steam-engines. (Being a communication.) May 4; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
April 20	1420	George Schofield	Sheffield	Thumb-bit and joint for joiners' brace-pad to act on the upright by pressure.
„	1421	Howard Ashton Holden	Birmingham	Carriage lamp.
„	1422	A. and M. Burton	John's-place, Blackfriars	Effluvia-valve and gulley-grate for small sewers and drains.
22	1423	Edwin Greenslade Bradford	Teignmouth	Brooch catch.
„	1424	Robert Best	Birmingham	Rack pulley.
„	1425	Samuel Gilbert, jun.	Stamford	Somapantic bath.
25	1426	Frederick Skinner	Sheffield	The Archimedean reel (fishing).
„	1427	William Riddle	Blackfriars-road	Folio clip.
„	1428	Walley & Hardwick	Oxford-street	A lady's mantle.
„	1429	George Palliser & Co.	Finsbury-place North	Improved buckle.
26	1430	Joseph Hines and John Nicholson	Bishop Auckland	Spring drill.
„	1431	Simcox, Pemberton, & Sons	Birmingham	Rack pulley.
„	1432	James Medwin	Regent-street	Resilient boot.
29	1433	Osmond Oliver	John-street, Tottenham-court-road	Nonpareil universal ventilator.
„	1434	Joseph W. Schlesinger	Clement's-lane, London	Expanding portfolio.
May 1	1435	William Riddle	Blackfriars-road	Label damper.
„	1436	William Riddle	Blackfriars-road	Foot bath.
„	1437	William Scott	Exeter	Trap for drains.
2	1438	Robertson and Jobson	Sheffield	Register stove.
„	1439	Welch, Margetson & Co.	Cheapside	Shirt vest.
„	1440	Samuel Roberts and Joseph Slater	Sheffield	Asparagus tongs.
4	1441	Henry Curtis	Moor-end, Hambrook, near Bristol	Ribbed deep draining tool, for clay and tenacious soils.

CONTENTS OF THIS NUMBER.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1292.] SATURDAY, MAY 13, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

DAVISON AND SYMINGTON'S NEW COFFEE ROASTER.

Fig. 3.

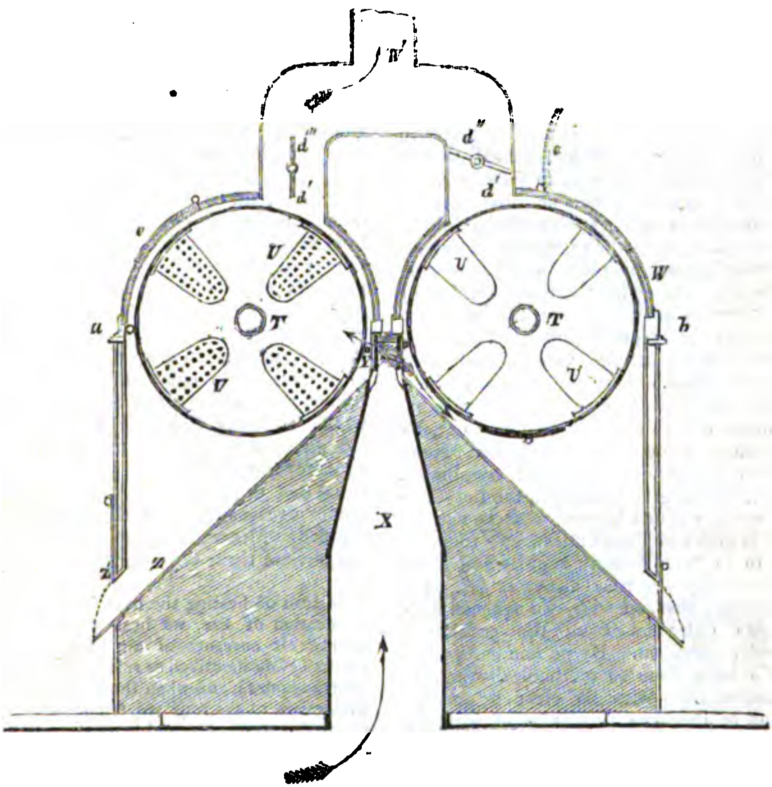
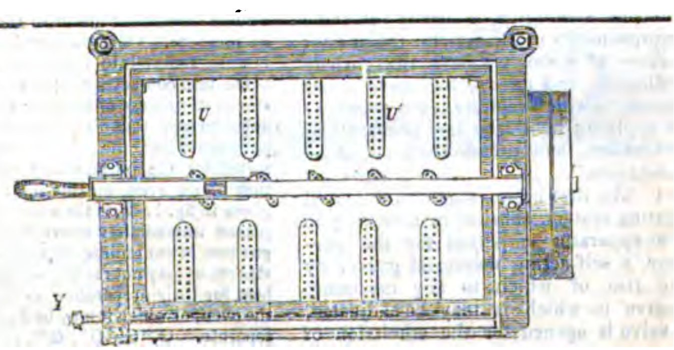


Fig. 4.



MESSRS. DAVISON AND SYMINGTON'S FURTHER IMPROVEMENTS IN EVAPORATION AND DESSICATION—NEW COFFEE ROASTER—NEW BAKING OVEN, ETC.

[Patent dated November 6, 1847. Specification enrolled May 6, 1848.]

We have repeatedly had occasion during the last four years to notice the new system of evaporation and dessication introduced by Messrs. Davison and Symington, (see particularly vol. xl., p. 338, and vol. xlvii., p. 202,) to point out its various uses and applications, and to record the rapid progress which it has deservedly made in public estimation. The distinguishing feature of this system, it will be recollected, consists in causing currents of air, heated to any degree of temperature, to pass in *rapid* contact with the bodies or substances requiring dessication, such as timber, cloth, yarns, &c., or needing preparation by heat for alimentary purposes, as coffee, cocoa, biscuits, &c. The mere application of hot air to such uses, was of course no novelty; hot pipes, hot plates, hot chambers, of an infinite variety, had been before used. But the hot air, when once admitted into any place, was commonly left to find its own way out, by virtue of its own ascensive power. Now, what Messrs. Davison and Symington did, was to give velocity to the hot air—a velocity much beyond what is natural to it under any circumstances; to cause it to do its duty more rapidly and more effectually—to pass away, as fast as it becomes charged with the aqueous particles extracted from the substances under operation. By no one before had this been done so methodically and so successfully—with so clear a perception of the true principles of artificial evaporation, or so business-like an application of it to practice.

The present patent of Messrs. Davison and Symington, is partly for some improvements in the system, the master feature of which we have thus briefly indicated, and partly, for some other modes (to which rapidity is not essential) of applying heat "to the preparation, dessication, and preservation of edible substances."

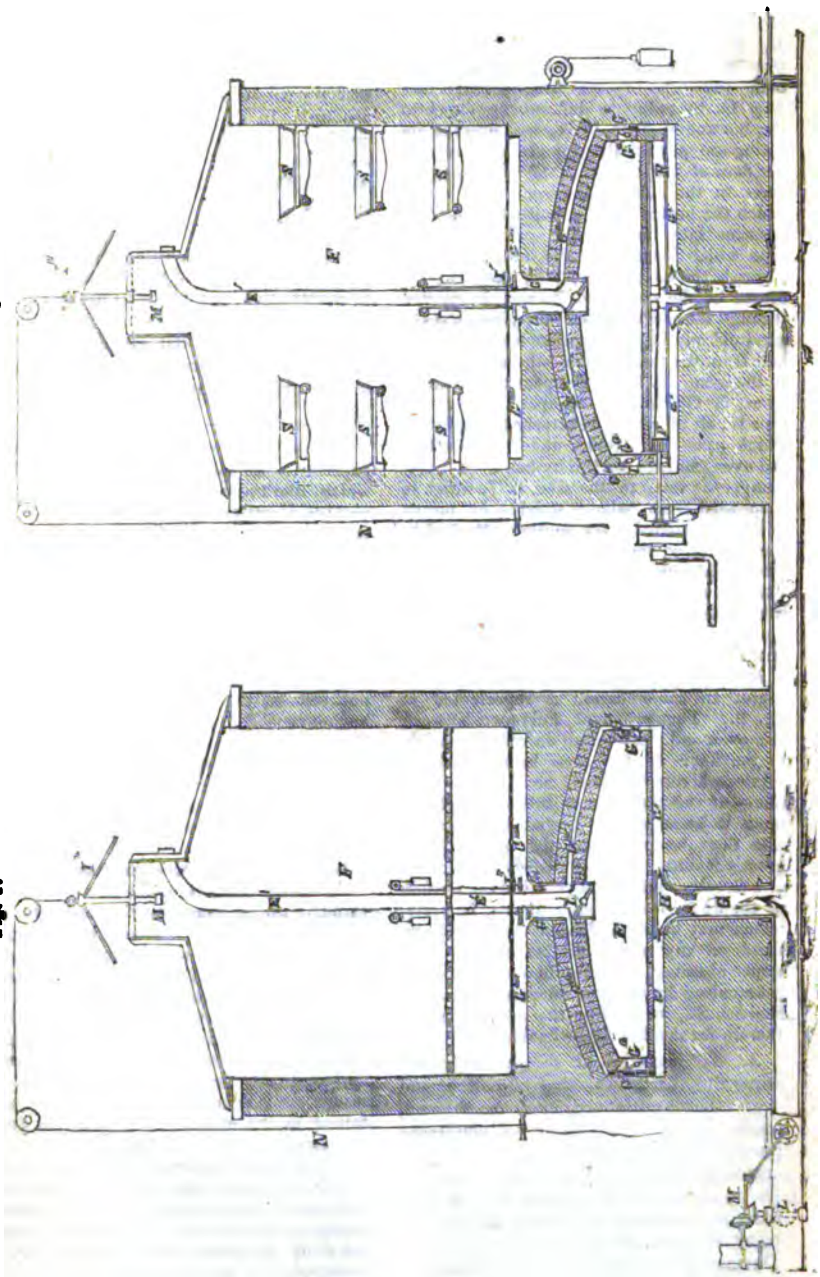
1. The first improvement in the rapid heating system, consists in attaching to the apparatus employed for the purpose, a self-acting mercurial gauge, by the rise of which to any maximum degree to which it may be adjusted, a valve is opened for the admission of cold air to keep down the temperature. (See L M, fig. 1.)

2. A second improvement has an exclusive relation to the application of rapid currents of heated air "to the baking of bread stuffs, confectionary, meats, and other edible substances usually prepared in ovens, or drying or hot chambers." According to the common method of baking in an oven, the oven is first heated by the direct application of fire to the interior, after which the fire is withdrawn, and the bread or other article is introduced, to be afterwards baked by the heat radiated from the walls of the oven. One evil consequence of this mode of proceeding is, that the interior of the oven, unavoidably retains on its surface more or less of the products of combustion (always of an uncleanly, and often of a pernicious character,) which act injuriously on the bread or other article which is being baked. Another evil consequence is, that the oven cannot be kept, for howsoever short a period, at an equal and uniform heat; the heat gradually decreasing after the drawing of the fire. Messrs. Davison and Symington obviate these objections in this way:

Instead of heating the oven by the direct application of fire, we heat it by passing through it currents of air heated by the means before described or referred to, to any degree required, and when the oven has been thus raised to the required temperature, we shut off the currents, and leave them to circulate through passages or flues made in the walls of the oven, and we attach to these passages or flues valves or dampers, whereby we can keep up or diminish the temperature at pleasure. Only pure and unvitiated air is thus suffered to enter into the oven or come into contact with the material or substance in process of baking; and we are enabled to keep that air at any degree of temperature which the operator may find best suited for the purpose. A sectional elevation of an oven, on this improved plan, is given in fig. 1. E, is the oven; F, a chamber placed immediately above the oven for the purpose of containing such materials or substances as may not require so high a degree of heat for their preparation as those placed in the oven, or which it may be desirable to keep separate. G, G′, G″, G‴, G⁗, G′′′′′, are

Fig. 2.

Fig. 1.



x 2

the passages or flues into and through which the hot air flows to the oven and the chamber above it from the discharge-pipe, D, of the heating apparatus.* H, is an iron plate which is placed immediately over the top of the first vertical air-flue, G, in order to deflect the air into the horizontal flues, G′ G′, and prevent its acting too powerfully against the centre of the floor of the oven, E. G^a G^a, are apertures in the side of the oven, E, through which the heated air is admitted in the first instance into the interior. E′, is a vent-pipe which leads from the top of the oven through the air-passage, G‴, passes up the centre of the chamber, F, and is carried through the roof,—which vent-pipe serves to carry off any impure vapours which may exhale from the materials or substances placed in the oven. I I, are dampers to the apertures, G^a G^a, and I′ a damper to the vent-pipe E′, all of which are attached to spindles which pass out through the front wall of the oven, and are worked by hand. I″, is a damper or valve to the flue, G‴, which is suspended from balance weights by means of chains carried over pulleys attached to the outside of the vent-pipe, E. M, is another vent pipe for the escape of the used or vitiated air from the upper chamber, F, which may be opened or closed as required by means of a damper, I‴, worked by a chain or rope, N, from below.

A modification of this oven, which may be useful in some cases, is represented in fig. 2. The principal difference between this oven and that before described consists in the floor of the oven being made to rotate, whereby there will be a greater certainty of the materials or substances placed upon it being equally heated, and whereby also their removal from the oven will be greatly facilitated. This is effected by means of a circular rack, R, attached to the bottom of the floor, into which a pinion, P, gears, which may be worked from the outside by hand or any other suitable power. The upper chamber, F, shows how space may be economised by using a number of trays or shelves, SS, for holding the articles placed therein for dessicating or baking

3. We come next to an improved apparatus for the roasting of coffee, and "of other substances, such as chicory, cocoa, barley when used for colouring purposes in brewing," &c. The fatal accident which has just happened to Mr. Dakin, from the explosion of a coffee-roasting machine, of which he was the patentee, gives to this portion of Messrs. Davison and Symington's specification a high degree of present interest. Without wishing to countenance, and still less to inflame, the prejudice which such an occurrence is but too apt to excite against what may be, nevertheless, a most meritorious invention, (Mr. Dakin left it still unspecified, but, from the accounts in the newspapers, it would appear to consist in the application to coffee-roasting of the hot-water plates of Messrs. Brown and Co., whose specification is given in another part of our present Number,) we may remark that the principle of *rapid efflux*, on which Messrs. Davison and Symington's machine is constructed, is such as to make explosion from excess of pressure next to impossible. A sectional elevation of this apparatus is represented in fig. 3, and a half plan of it on the line *ab* in fig. 4.

TT are two revolving cylinders mounted parallel to one another in a suitable casing, which, like those of the coffee-roasting apparatus described in the specification of our former patent, are perforated all over with small holes for the admission of the heated air. In the sides of each cylinder there are a number of cavities, or recesses, of a U form, which are perforated like the rest of the circumference, and serve to introduce the heated air more effectually into the interior; and in order that the berries may not rest on the exterior of these cavities, but move about freely within the cylinder, the cavities on one side are placed skew-wise in relation to those on the opposite side, (see fig. 4.) Each cylinder is covered lengthwise, by a close semi-cylindrical cover, W, which is formed of two plates with charcoal dust, or some other non-heat conducting substance inserted between them, and in each cover there is a valve, or door, *d*, through which access may be had to the door of the cylinder, for the introduction of the coffee, and also an aperture, d^1, for the escape into the vent-pipe, W^1, of any noxious vapours which may exhale from the coffee in the first stages of the preparation, and before its aromatic properties begin to develope themselves; which last-mentioned aperture, d^1, is opened and closed by means of a damper, d^2. The coffee contained in the cylinder is discharged from it down an inclined plane, or shoot, Z, which obviates the necessity of shifting the cylinders for the purpose of discharging, and allows the cylinders to remain permanently in their places. At the lower extremity of the shoot there is a shutter, or valve, Z^1, to prevent any escape of the heated air when the shoot is not in use. The

means of giving rotation to the cylinders are similar to those made use of in the apparatus described in the specification of our former patent. X is the passage for the inlet of the heated air to the two cylinders, and Y is a slide, by which the air is admitted or shut off at pleasure.

4. "Improved methods of applying rapid currents of heated air to the dessication and preservation of animal substances:"

If the substances are of large bulk, such as carrots, turnips, parsnips, &c. (but excepting always potatoes,) we first wash them, and also scrape them when necessary; next cut or slice them by hand, or by any suitable machinery, and then lay them in thin layers upon trays (with hair-cloth or lattice-work bottoms,) and place these trays on racks, one above another, in the heating chamber. When thoroughly dessicated they may be then either put up in packages, or previously to packing be reduced to a very comminuted state; and in either case it is desirable that the packages should be made air-tight. To preserve potatoes, we prefer first to boil or steam them, then to peel them, and afterwards to wash or otherwise reduce them to a state fit for spreading in thin layers upon trays, of the same description as those employed in the preceding process. We then expose these trays, with the substance or material, to impelled currents of heated air, as before described, at a temperature of about 150° Fahrenheit, till the substance or material is thoroughly dessicated. If the substances or material are of small size—such as pulse, peas, or beans—we expose them in their entire state to the rapid currents of heated air.

5. "An improved method of applying rapid currents of heated air to the preservation of meats:"

We find it most convenient first to cut the meat when bulky into slices of about half an inch thick, and hang these slices on lines or rails, where we expose them to rapid currents of heated air. The temperature we find most suitable is from 120° to 160°, but it should not much exceed the latter degree. All moisture is by this means completely expelled from the meat, and its albumen, at the same time, firmly coagulated. Meat which has been so treated will continue for a long time, under ordinary circumstances, in a perfectly wholesome state; but if intended to be exported to damp or variable climates, we recommend that it should be treated with a little highly-diluted pyroligneous acid, or some other approved antiseptic, to prevent it from re-imbibing humidity; after, which it should be subjected to a further heating, in order to free it from any moisture which the acid or other antiseptic may have imparted to it. To ascertain when the meat has been perfectly dried, a portion of it may be weighed at intervals, and when it ceases to show any diminution of weight, the process may be deemed complete.

6. "An improved method of applying heat to the preservation of the edible matters contained in eggs:"

We first strip the eggs of their shells, then intimately mix together the yolks and whites; next add about an equal weight of wheaten flour, ground rice, or other farinaceous substance, and beat up the whole into an uniform mass, which we spread upon trays with horse-hair cloth or lattice-work bottoms, and then expose the mass so spread out, to a temperature of about, but not much exceeding, 180° Fahr. (whether the heat is applied in rapid currents or not is in this case a matter of indifference.) When thoroughly dried, the mass is reduced to the state of flour; and in that state packed up for use. Or, instead of thus mixing up the yolks and whites of the eggs together, we preserve them separately; following the same process in regard to the mixing of each with flour or other farinaceous substance, and then dessicating the compound mass, as has just been described. Or instead of adopting either of the preceding processes, we dessicate the eggs in their entire state, denuded only of their shells, or the yolks and whites separately, and then reduce them to a state of flour without any intermixture with other substances.

We make little doubt but that this egg-flour will soon become a most extensive article of commerce.

ELECTRIC CLOCKS.

Sir,—Permit me to inform your correspondent, Mr. Hislop (in p. 342 of your current Volume,) that his suggestion has been long ago anticipated. A reference to vol. xl., p. 325, of your useful Magazine, will show that an arrangement such as Mr. H. contemplates has been most successfully accomplished by an ingenious watchmaker of Bath, Mr. G. Wadham. This "Rémontoir Electrical Clock" (so it has since been called) has been in the possession of your present correspondent above four years, and fully justifies the encomium pronounced upon it at its first construction.

I am, Sir, yours, &c., F. L.

May 2, 1848.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

Sir,—The question, whether sloping or vertical walls are the best calculated to resist the encroachments of the sea, is one on which, as is usual with most questions, much may be said on both sides; but, certainly, it is not one on which an opinion either way deserves to be treated with derision. The Reviewer of "Sir John Rennie's Account of the Plymouth Breakwater" (p. 427) would seem to imagine that it is quite sufficient, to dispose of the Report of the Dover Harbour Commissioners in favour of vertical walls, to tail the statement of the fact with a point of admiration ("!") He is in an ecstasy of wonder, apparently, that the Commission should have proposed anything so monstrous. And yet, among the authorities by whose opinions the Commissioners were guided in coming to this "monstrous" conclusion, we find the names of Airy, Barlow, Burgoyne, De la Beche, and Brunel, to say nothing of a host of persons of minor repute. Surely it may be permitted to the Commissioners to agree with such distinguished men as these, without any serious implication of their characters, either for science or common sense. Instead of their doing so being a cause for wonder, it seems to me that the wonder would have been, had they presumed to differ from them. True it is, the report of the Commissioners runs counter to what has been hitherto the prevailing opinion of engineers on this subject—most true that, if the Dover Breakwater be constructed as they recommend, it will be, at best, a bold experiment. As the Commissioners themselves, however, observe in their Report, "breakwaters made by dropping blocks of stone into the sea, and forming a long slope, *were also experiments*, and experiments, too, which in numerous cases now serve as warnings to those who may have to decide upon the construction of such works." The more adverse the Report is to long-established and long-cherished notions—backed as it is by some of the first lights of the age—the more it ought to incline us to investigate seriously the grounds on which it rests. And conceiving, Sir, that the pages of your useful work can never be so well employed, as in assisting to dispel error on practical points, I venture to hope—the tall bully ("!") who frowns at me, notwithstanding—that you will find room for an extract or two from what Professor Airy has advanced, by way of apology for this "modern crotchet," as your Reviewer terms it. I confine myself to his testimony, because I think it will weigh most with your readers, and for the sake also of not trespassing too much on your columns.

Professor Airy's Opinion.

"The forms of breakwater which have been adopted in, or proposed for, important works of this description, are three, namely,—

"1. An upright wall.

"2. A long slope, as in the Plymouth Breakwater.

"3. A long slope crowned by a perpendicular wall, as in the Digue of Cherbourg.

"I will remark on these in the order in which I have enumerated them.

"(1.) The peculiarity in the effects of an upright wall from the bottom of the sea, is this, that the sea does not *break* upon it. I can hardly conceive that engineers in general are not aware of this peculiarity, yet I never saw allusion made to it, and I do not think that they are usually aware of the vast importance of this peculiarity in reference to such questions as that now before the Harbour Commission. I may perhaps be permitted here to allude to observations of my own, which (although they first strongly impressed this law of the movements (of water upon myself), it would be puerile to mention, if I did not think it likely that they would recal to the minds of the members of the Commission their own personal observations bearing on the same subject. I once rowed out of Swansea harbour at high water (with fully 20 feet of water about the pier-heads), when a very high sea was running. We passed so near to one pier-head, that we could touch it with the oars; but there was no breaking, and no fear of the boat touching the pier, though we were raised and depressed many feet. Before we had left it 200 yards, we passed over a shoal, where the sea broke so heavily, that it carried out of the boat the two rowers next to myself, and nearly filled the boat, and with great difficulty we gained the beach. On another occasion, in rowing

past some of the perpendicular cliffs descending into deep water on the east side of the Lizard, I remarked the unbroken character of the swell, but on the sloping sands of Cadgwith there was a high surf. In the same manner, an engineer of eminence has stated to me how strong was his impression, on seeing the high swell unbroken on the cliffs, descending into deep water at the Bay head of Valentia. Since making these observations, I have had ample opportunities of inquiring theoretically into the matter, and the result is the same—that no breaking will be caused by a wall rising perpendicularly from the bottom. The water will gradually rise and fall, causing a slowly-varying pressure against the surface of the wall; but there will be nothing like the heavy blow of a breaking sea, or like its spray, which is driven with such force as to search through every joint of the masonry.

"I do therefore conceive that a wall, built with a perpendicular sea-face from the bottom of the sea, is a form perfectly proper for a breakwater, and that with the most moderate care it may be maintained in a state of complete repair. I always suppose the water to be pretty deep, so that the circumstances shall not approach to the disadvantageous state to which I shall allude in speaking of the third construction.

"(2.) The disadvantageous effect of a long slope, like that of the Plymouth Breakwater is, that the sea breaks heavily upon it. The advantageous circumstance is, that the position of the stones of the masonry is such, that the violence of the breakers will not easily dislodge them. Yet experience has shown that this position does not save them, unless the masonry consists of the heaviest squared stones, arranged with the nicest attention to the joints. I believe that less care would save a perpendicular wall. It is impossible for a ship that is near to avoid being carried upon the slope, and there dashed to pieces: the danger near a perpendicular wall is much less. The quantity of water which passes over such a breakwater must be very great, but I know not whether it will cause any practical inconvenience. On the whole, I state as my opinion that this is a very good practical construction, but that, as far as it is possible to judge of another construction yet untried on the large scale, I prefer a perpendicular wall.

"(3.) The third construction, namely, that of a slope surmounted by a perpendicular wall, is without doubt the worst of all. By the slope, the sea is made to break very heavily, and in this breaking state it strikes the wall, which is placed in the position adapted precisely to expose the masonry to the greatest violence. (The same remarks apply in all respects to a perpendicular wall built in shallow water, or upon sloping sands, and it is undoubtedly in this way that the piers at Whitehaven, and other places, have been destroyed.) When I was upon the Digue at Cherbourg, the state of the tide was such, that in some parts the slope was just exposed, while in other parts it was covered, and though there was but a most trifling breeze, and the water was very smooth, the spray from the sea breaking on the exposed parts of the slope, and striking the face of the wall, made it difficult to walk upon those parts of the Digue. The resident authorities of the Digue pointed out to me some squared stones lying upon the promenade of the digue, weighing probably two or three tons, and assuring me that these stones were frequently displaced by the masses of solid spray, which are thrown upwards when the sea breaks and strikes the face of the wall, and which then descend upon the promenade. When it is considered that the original motion of this broken water in its breaking state is horizontal, and that it is most suddenly changed into the vertical motion by the obstruction of the wall, and, therefore, that the force which is required to produce that great change of motion in a very short time, is the exact measure of the force sustained by the wall, it will be seen that that pressure is enormous, and that nothing but the most perfect masonry can resist it. The displacement of a single facing stone might be expected to ruin the whole digue. The construction would be exposed to less danger if the section of the wall presented to the sea a hollow curve, like the base of the Eddystone lighthouse; but still there would be the breaking sea searching through every joint, and nothing can make square stone masonry quite secure when it is exposed to this."

I am, Sir, yours, &c., W.

Dover, April 26, 1848.

[We insert this communication with pleasure, but must, in justice to the side of the question espoused by the Reviewer, take an early opportunity of returning to the subject.—Ed. M. M.]

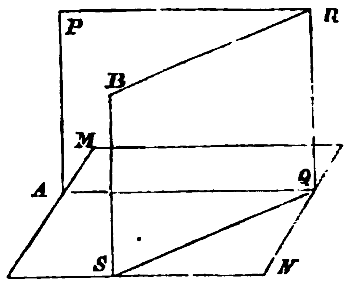
GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. AND E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from page 317.)

PROP. XXXVII.

If two planes which intersect be each of them perpendicular to the same plane, their common section will also be perpendicular to that plane.

Let the planes PQ, RS which intersect in QR be perpendicular to the plane MN: then their intersection QR will be perpendicular to MN.



For, take any points A, S in the lines of section QA, QS of these planes with MN; and draw AP in PQ, and SB in RS, respectively perpendicular to AQ, QS.

Then, since AP is perpendicular to AQ, it is perpendicular to the plane MN (*prop* 32); and similarly SB is perpendicular to MN. Whence AP, SB are parallel (*prop.* 35); and the planes PQ, RS drawn through them, have their intersection QR parallel to both of them (*prop.* 4); and consequently, since AP, one of these lines, is perpendicular to MN, the other QR, is also perpendicular to it.

COROLLARY.

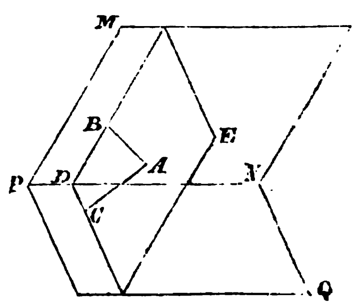
This proposition often occurs under another form, to which the same demonstration applies.

If a plane be perpendicular to each of two other planes it will be perpendicular to their common section.

PROP. XXXVIII.

If, from any point, perpendiculars be drawn to two planes which meet, the plane drawn through these lines will form a profile angle of the planes; and the angle contained by the lines will be the supplement of the profile angle of the planes.

(1.) From any point A let perpendiculars AB, AC be drawn to the planes MN, PQ (which meet in PN); then, if the plane DE be drawn through AB, AC, it will be a profile plane to the planes MN, PQ.



For, since DE passes through AB, which is perpendicular to MN, it is itself perpendicular to MN (*prop.* 31); and similarly it is perpendicular to PQ, whence it is perpendicular to their section PN (*prop.* 37, *cor.*); and hence BD, DC being perpendicular to PN, the angle BDC is the profile of the dihedral angle MN PQ, and their plane a profile plane of that dihedral angle.

(2.) The angle BAC is the supplement of the profile angle BDC.

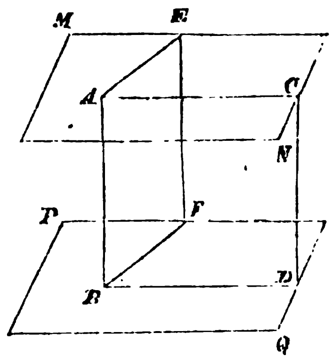
For, since AB is perpendicular to the plane MN, the angle ABD is a right angle (*prop.* 24); and in the same manner it follows that ACD is a right angle.

But the four angles of the quadrilateral ABDC are together equal to form right angles (*Euc.* i., 32 *cor.*); and ABD, ACD, two of them, are right angles; whence

the remaining two, BAC, BDC, are together equal to two right angles. That is, BAC is the supplement of BDC.

Prop. XXXIX.

If a line be perpendicular to one of two parallel planes it will be perpendicular to the other; and if two planes be perpendicular to a line they will be parallel to one another.



(1.) Let the line AB be perpendicular to MN, one of the two parallel planes MN, PQ; then it will be perpendicular to PQ, the other.

For, through AB draw any plane AD, cutting MN in AC, and PQ in BD.

Then, (*prop.* 1) AC, BD are parallel, and the angles DBA, BAC are together equal to two right angles. Also, since AB is perpendicular to MN, the angle BAC is a right angle (*prop.* 24); and hence ABD is a right angle.

In the same manner, if any other plane AF, be drawn through AB, to cut PQ in BF, the angle ABF may be proved to be a right angle.

Whence AB is perpendicular to two lines BD, BF in the plane PQ: that is, AB is perpendicular to the plane PQ itself.

(2.) Let the two planes MN, PQ be perpendicular to the same straight line AB: they will be parallel to one another.

For, through AB draw any two planes AD and AF, to cut MN in AC and AE, and PQ in BD and BF.

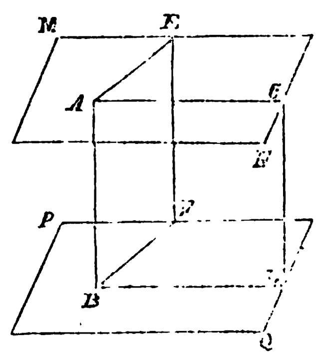
Then, since AB is perpendicular to the plane MN, the angle BAC is a right angle; and since AB is perpendicular to PQ, the angle ABD is a right angle. Whence, in the plane AD, the lines AC, BD are drawn at right angles to AB; and they are, therefore, parallel.

In the same manner, it may be proved that AE, BF are parallel.

Hence, the two lines CA, AE in the plane MN being repectively parallel to the two DB, BF in the plane PQ, the planes MN, PQ are themselves parallel (*prop.* 7).

Prop. XL.

If a plane be perpendicular to one of two parallel planes, it will be perpendicular to the other.



Let the plane AD be perpendicular to MN, one of the two parallel planes MN, PQ: it will then be perpendicular to PQ, the other.

For, let AC, BD be the sections of AD with the parallel planes MN, PQ; and from any point B of the line BD draw in the plane AD, a line AB perpendicular to AC. Then, since the plane AD is perpendicular to MN, the line AB is also perpendicular to the plane MN (*prop.* 32); and hence AB being perpendicular to MN one of the two parallel planes MN, PQ, it is perpendicular to the other PQ (*prop.* 39). Consequently the plane AD through AB is also perpendicular to PQ.

(*To be continued.*)

MATHEMATICAL PERIODICALS.

(Continued from page 402.)

V. *The Gentleman's Mathematical Companion.*

Classification of the second series of questions.

I. ***Arithmetic.*** – Questions 201, 307, 413, 530, 578.

II. *Algebra.*—Ques. 1, 2, 71, 132, 134, 142, 231, 248, 281, 404, 405, 458, 482, 484—486, 497, 500—502, 511, 549, 574, 575, 607, 626, 650.

III. *Application of Algebra to Geometry and Mensuration.*—Ques. 3, 5, 14, 73, 139, 162, 230, 232, 259, 274, 301, 345, 367, 400, 408, 414, 416, 420, 432, 445, 449, 480, 494, 496, 499, 503, 534, 538, 541, 543, 548, 570, 610, 611, 622, 629, 704.

IV. *Diophantine Analysis.*—Ques. 16, 17, 26, 27, 37, 39, 44, 77, 114, 124, 131, 134, 163, 164, 182, 188, 199, 200, 207—209, 252, 264, 265, 267, 286, 292, 310, 339, 351, 362, 363, 374, 396—398, 512, 514, 522, 526, 550, 556, 561, 562, 564, 584, 585, 589, 600, 601, 608, 609, 613, 619, 634, 640—643, 662, 672—674, 691, 692, 695, 705, 706, 709, 721, 722, 726—728, 730, 735.

V. *Geometry, Geometrical Analysis, and Construction.*—Ques. 6—11, 13, 15, 19, 22—25, 28, 30, 31, 33, 35, 36, 40—43, 45—47, 49, 50, 51, 53—59, 61—66, 69, 72, 74, 75, 79, 81, 84—98, 100, 108—114, 117, 118, 122, 125—127, 133, 135—138, 140, 141, 143—149, 152, 154, 156, 158, 160, 161, 165—168, 171—179, 181, 183—187, 192, 197, 202—206, 210, 211, 213, 215—223, 229, 233—246, 249—251, 253, 260—263, 266, 268—270, 272, 274, 280, 287, 288, 290, 291, 293—298, 309, 312, 315—317, 319—322, 325, 327—332, 336, 342, 344, 347—350, 352—354, 357, 370, 378, 380—391, 400, 409, 415, 418—422, 424, 425, 427—431, 434, 441—444, 450—452, 455, 456, 459—473, 483, 488, 490—493, 495, 504—510, 513, 518—521, 524, 532, 535—537, 540, 542, 544, 546, 552, 554, 558, 559, 565, 570, 572, 573, 581, 586, 582, 587, 590—593, 595, 598, 599, 602, 604—606, 611, 614, 620, 621, 623—625, 630, 631, 635, 638, 639, 644—646, 651, 657—659, 661, 664, 666, 667, 669, 670*, 678—680, 682, 687—690, 698—702, 707, 708, 711, 719, 723, 725, 729, 733.

VI. *Trigonometry, Plane and Spherical.*—Ques. 4, 18, 20, 38, 48, 82, 104, 105, 119, 120, 129, 130, 154, 155, 258, 283, 302, 303, 308, 311, 314, 338, 340, 343, 359, 364, 369, 372, 373, 375, 378, 379, 406, 407, 440, 473, 478, 479, 481, 525, 529, 533, 534, 547, 560, 571, 588, 597, 648, 682.

VII. *Loci, Properties of Curves, Rectification, Quadrature, &c.*—Ques. 21, 29, 32, 46, 52, 60, 70, 80—83, 115, 149, 150, 153, 157, 165, 169, 170, 177, 180, 190, 195, 196, 212, 214, 227, 228, 255—257, 271, 273, 275, 277—279, 282, 299, 300, 313, 328, 329, 332—335, 337, 355—358, 360, 361, 366, 393, 403, 411, 426, 439, 447, 460, 474, 475, 492, 493, 515—517, 528, 555, 563, 567—569, 571, 583, 594, 596, 602, 605, 616—618, 629, 633, 636, 652—654, 656, 660, 675, 676, 681, 683—686, 696, 703, 712—720, 724, 731, 732.

VIII. *Fluxions.*—Ques. 12, 31, 76, 78, 103, 106, 107, 116, 141, 151, 159, 198, 211, 284, 285, 323, 346, 365, 366, 368, 376, 392, 395, 410, 412, 414, 417, 423, 432, 446, 454, 476, 477, 487, 489, 523, 603, 615, 628, 632, 647, 677, 693, 704.

IX. *Series.*—Ques. 224, 318, 341, 377, 401, 402, 433, 435—438, 448, 453, 457, 498, 566, 612, 628, 668, 736.

X. *Mechanics, including Statics and Dynamics.*—Ques. 34, 67, 99, 101, 106, 107, 121, 123, 128, 189, 191, 193, 194, 225, 226, 247, 254, 276, 304—306, 324, 346, 367, 371, 394, 399, 420, 527, 528, 531, 539, 545, 551, 553, 557, 577, 632, 655, 663, 665, 670, 671, 694, 697, 710, 734.

XI. *Hydrostatics, &c.*—Ques. 68, 102, 289, 326, 576, 580, 627, 637.

N.B. When a dash occurs between two numbers, it indicates that all the questions between them are of the same kind, and when the same question occurs under different heads, it is solved by various methods.

*** *Remarks.*—Questions 13, 54, 112, 245, 491, 535, 581 of this series relate to points ranging in a right line, and lines passing through a point—two classes of propositions to which the theory of transversals and the co-ordinate methods have latterly been effectively applied: a few threadbare examples of the latter class form almost the whole "stock-in-trade" of most treatises on analytical geometry, so far as regards the theory of the right line and its applications.

Question 67 determines the position of the flood-gates in a river or canal, so as to resist the pressure of the water with the greatest ease. The subject, it appears, was originally discussed by Muller and Martin, and also formed question 228 in the *Gentleman's Diary*, which was proposed and answered by Mr Wildbore, on the supposition that Messrs. Muller and Martin's results were correct.

It was re-proposed in the *Companion* by "Mechanicus," and solutions were given in the following number by Messrs. Wolfenden and Fletcher, who produced different results from those before mentioned, and agreed in considering the preceding solutions erroneous. Dr. Hutton also considered the subject at p. 262, vol. iii., of his "Course of Mathematics;" but his investigation not appearing satisfactory, the question was again proposed, as No. 670, in the *Companion*, by Mr. John Ray, of Royton, who, in his solution, confirms Mr. Wolfenden's results.

The 69th question is a geometrical one of some importance, from the failures of the eminent geometers who have attempted its solution. The editor of the *Gentleman's Diary* and Mr. Campbell failed in their solutions to the question No. 841 in the *Diary* for 1803. It was afterwards proposed in the *Companion*, for a *geometrical* solution, by Mr. William Smith, of Liverpool; and in the following number solutions were given by Messrs. Whitley, Wolfenden, Amicus, and John Wright, of Norley. None of these were correct, except that by Mr. Wolfenden, and his could scarcely be called a geometrical one. The proposer's investigation having been lost or mislaid, was printed in the *Companion* for 1808, and is characterised by being at once simple, elegant, and satisfactory. A similar question, No. 127, was proposed by Mr. Swale, and an elegant solution was given to it in the following number by Mr. Garnett, of Newcastle-upon-Tyne, who, in an appended remark, notices some of the previous attempts at solution, and gives a sketch of the history of the problem.

Quest. 196, 229, 257, 280 relate to envelopes and the parallelogram circumscribed about an ellipse—a subject upon which Mr. Fenwick has published an elegant paper, in pp. 119—122, vol. ii. *Mathematician*.

The 197th question furnishes the analysis of the 46th, 47th, and 48th problems in the Appendix to *Simpson's Geometry*, and also a new solution to the 45th problem. These investigations are reprinted by Professor Leybourn, in vol. iv. of his edition of the *Ladies' Diary*, where also may be found abundant information respecting these celebrated problems of antiquity. Question 248 shows how Simpson's rule for biquadratics may be derived by considering the equation as the product of two quadratics; and No. 386 supplies a neat solution to Prob. 59, in the Appendix to *Simpson's Algebra*. Four demonstrations of Lhuillier's Theorem (Prop. 10, Davies's *Horæ Geom.*, L. D., 1835,) are given in question 418, all of which possess considerable merit, and improved demonstrations of the method of determining the area of a triangle from the three sides, are furnished in question 470.

Questions 436, 480, 570 are in illustration of Mr. Gompertz's "Principles of Imaginary Quantities," the last-named question being a porism to which he applies his "cases of ease," and on which subject Professor Davies offers some remarks in his excellent paper on Porisms, in pp. 42—64, vol. i. of the *Mathematician*. Mr. Gompertz likewise furnished various questions in the "Theory of Functions" and "Mechanics," nearly all of which are of the highest order of difficulty, and prove him to have been in advance of most mathematicians of the time. Question 546 supplies a defect in the demonstration of Prop. 1, B. 3 of "Simson's Euclid." Questions 570, 606, 639 are porisms, to which both algebraical and geometrical investigations are given; and No. 719, by Mr. Godward, furnishes a correction to Prop. 1, p. 324 of Leslie's "Geometry of Curve Lines."

To point out cases of individual elegance would almost be a hopeless task; where there is so much nearly equal in merit, a selection becomes extremely difficult. In the earlier numbers, the names of Butterworth, Cunliffe, Lowry, Wallace, Whitley, Swale, Smith, Wright, &c., are a sufficient guarantee that the questions and their solutions are of no ordinary kind; and in the latter numbers, when the staff of contributors was increased by Clay, Davies, Gill, Gompertz, Holt, Rutherford, Winward, Woolhouse, Young, &c., no selection is necessary to point out any distinctive beauties in their uniformly elegant and original investigations.

Contributors.—Among the principal contributors may be mentioned Abbutt, Anderson, Baines, Baker, Butterworth, Clay, Cunliffe, senior, Cunliffe, junior, Dawes, Duckett, Edwards, Fletcher, Fowls, Gompertz, Hilton, Holt, Johnson, Jones, Kay, "A. B. L.," Lowry, New-

ton, Nicholson, Nesbit, Rangeley, Rutherford, Ryley, Scott, Smith, Swale, Wallace, Watson, Whitley, Winward, Wolfenden, Woolhouse, Wright, and Young.

Publication.—The work was published about the beginning of November in each year; the early numbers by the editor, Mr. Davis, &c., and latterly by Davis and Dickson, London.

THOS. WILKINSON.

Burnley, Lancashire, May 6, 1848.

STEEL TIRES.

We quote the following remarkable statement of the advantages attending the plan recently adopted on some lines, of steeling the tires of railway wheels, (Banks' Patent,) from a statement laid before the last Quarterly Meeting of the Institute of Mechanical Engineers.

The present cost of Low Moor iron tires, for three-feet wheels, will be—

	£	s.	d.
Four tires of 3 cwt. each - 12 cwt. at 22s.	£13	4	0
Putting on the tires ready for work.........	8	0	0
Twice turning up after wearing hollow ...	1	0	0
Total cost	22	4	0

Suppose these tires to run 50,000 miles on an average; that is, 50,000 miles at a cost of 22*l.* 4*s.*; the present cost of Staffordshire tires will be—

	£	s.	d.
Four tires of 3 cwt. each—12 cwt. at 12s.	£7	4	0
Putting on the tires ready for work	8	0	0
Steel for steeling one set—1½ cwt. at 42s.	3	3	0
Man's wages for turning grooves in the wheels	0	10	0
Smith's wages for inserting the steel......	0	10	0
Man's wages for turning up after steeling	0	10	0
Men's wages for drilling and rivetting	0	7	6
Total cost	20	4	6

These tires are proved to run before steeling, 18,000 miles, and after steeling, 100,000 miles; making a total work of 118,000 miles, at a cost of 20*l.* 4*s.* 6*d.* Now, subtracting 50,000 miles, the work of Low Moor tires, from 118,000 miles, the work of Staffordshire tires, steeled, we have 68,000 miles, which the latter will run more than the former, and at a cost of 39*s.* 6*d.* per set less. From the above statement we see the cost of Low Moor tires per 1,000 miles is 8*s.* 10½*d.*, whilst the cost of Staffordshire tires, steeled, is only 3*s.* 5½*d.* per 1,000 miles. The truth of this statement is proved by a test of nearly five years' trial on those lines on which the plan has been most used. We are aware that railways do not all wear out the tires alike; but on those lines where the iron tires will run more than stated above, the steel tires will run more in proportion, and the plan is attended with no danger whatever.

Besides, the above statement shows only the advantage of steeling the tires once, but we have steeled many a second time, after they have run the above distance. The same tires may be steeled a second time, at a cost of 5*l.* per set, when they will run 100,000 miles more, making a total of 218,000 miles, at a cost of 25*l.* 4*s.* 6*d.*, or 2*s.* 4*d.* per 1,000 miles. The advantages of steeling a second time is secured by taking the tires in time, while they have the requisite strength for steeling the first time. The general objection raised against the plan is, that there will be a deal of trouble to carry it out; but this objection, if properly examined, will be found to be without foundation. When the wheels want turning up, they must be taken from under the carriage or wagon, and when taken from under, the cutting of the grooves in the tires for the steel will not cost more than 5*s.* per pair in men's wages; and when the grooves are turned, one smith and three strikers will insert steel segments into ten pairs of 3-feet wheels in one day of ten hours, after which, turning up the steeled wheels will take very little more time than turning up without steeling; which proves that the trouble will not be so great as some people imagine, and nothing when the durability and saving which is effected is considered, by the tires being steeled on this plan."

AMERICAN PORK TRADE.

[From Report of the American Commissioners of Patents.]

Cincinnati being the centre of an immense corn-growing and hog-raising region, is, in fact, the principal pork market in the United States, and, without even the exception of Cork or Belfast, the largest in the world.

The business of putting up pork here for distant markets is of some twenty-six years standing; but it is only since 1833 that it has sprung into such importance.

From the year 1833, when 85,000 hogs were slaughtered, the business has gradually increased, until in 1847 it amounted to 250,000 hogs.

From the 8th to the 10th of November the pork season begins, and the hogs are sold by the farmers direct to the packers. When the quantity they own justifies it, some of these farmers drive, in one season, as high as one thousand head of hogs into their fields. From one hundred to three hundred are the common numbers, however.

		Lbs.	
420,000 head of hogs	yield	150,000	Pork.
„	„	21,000,000	Bacon.
„	„	13,800,000	Lard.

These are the products thus far of the pork house operators alone; that is to say, the articles thus referred to are put up in these establishments from the hams and shoulders, sides, leaf lard, and a small portion of the jowls.

The lard made in Cincinnati is exported in packages for the Havanna market, where, besides being extensively used, as in the United States, for cooking, it answers the purpose to which butter is applied in this country. It is shipped to the Atlantic markets also, for local use, as for export to England and France, either in the shape of leaves or in the lard oil, large quantities of which are manufactured in the east.

There is one establishment here which, besides putting up hams, &c., is extensively engaged in extracting the grease from the rest of the hog. This, during the present year, will probably operate on 30,000 hogs. It has seven large circular tanks, six of capacity to hold each 15,000 lbs., and one to hold 6,000 lbs. These receive the entire carcass with the exception of the hams, and the mass is subjected to steam process under a pressure of 70 lbs. to the square inch, the effect of which operation is to reduce the whole to one consistence and every bone to powder. The fat is drawn off by cocks, and the residuum, a mere earthy substance, is taken away for manure. Besides the hogs which reach this factory in entire carcases, the great mass of heads, ribs and backbones, tail pieces, feet, and the trimmings of the hogs cut up at different pork-houses, are subjected to the same process, in order to extract every particle of grease. This concern alone will turn out this season 3,600,000 lbs. of lard, five-eighths of which is No. 1. Nothing can surpass the purity and beauty of this lard, which is refined, as well as made, under steam process. Six hundred hogs per day pass through these tanks, one day with another.

I come now to the manufacture of lard oil, which is accomplished by divesting the lard of one of its constituent parts—stearine. There are probably thirty lard oil factories here, on a scale of more or less importance. The largest of these, whose operations are probably more extensive than any other in the United States, has manufactured heretofore into lard oil and stearine, 140,000 lbs. monthly, all the year round. The great increase of hogs for the present season will probably enlarge that busines this year fifty per cent.

11,000,000 lbs. of lard will be run into lard oil this year, two-sevenths of which will make stearine, the residue lard oil; or in other words, 24,000 barrels of lard oil, of 41 to 42 gallons each. The oil is exported to the Atlantic cities and foreign countries. Much the largest part of it is inferior lard, made of marsh-fed and still-fed hogs, and the material, to a great extent, comes from a distance, making no part of these tables. Lard oil, besides being sold for what it actually is, enters largely into the eastern states into the adulteration of sperm oil, and in France serves to reduce the cost of olive oil. The skill of the French chemist enables them to incorporate from 65 to 70 per cent. of lard oil with that of olive. The presence of lard oil can be detected, however, by a deposit of stearine, small portions of which always remain with that article, and will be found at the bottom of the bottle.

I now come to the stearine candles made of the stearine expressed from the lard in the manufacture of lard oil. The stearine is subjected to hydraulic pressure, by which three-eighths of it is discharged as an impure oleine. This last is employed in the manufacture of soap; 3,000,000 lbs. stearine, at least, have been made in one year into stearine candles and soap in these factories, and they are prepared to manufacture 6,000 lbs. of candles per average day, throughout the whole year. The manufacture of this year will probably approach that amount, as the present supply promises the raw material in abundance.

From the slaughter, the offal capable of producing grease goes to another description of grease extractors, where are also taken hogs dying of disease or by accident, and meat that is spoiling through unfavourable weather or want of care. The grease made here goes into the soap manufacture. Lard is computed to form 80 per cent. of all the fat used in the making of soap. Of the ordinary soap, 100,000 lbs. are made weekly, equal, at four cents per pound, to 200,000 dollars per annum. This is exclusive of fine soap and of soft soap, which are probably worth 25 per cent. more.

Glue to an inconsiderable amount is made of the hoofs of hogs.

At the rear of these operations comes bristle dressing for the Atlantic markets. This business employs 100 hands, and affords a product worth 50,000 dollars.

Last of all comes the disposition of what cannot be used for other purposes, the hard hoofs and other offal. These are employed in the manufacture of prussiate of potash, to the product of which also contribute the cracklings or residuum left in expressing the lard. The prussiate of potash is used extensively in the print factories of New England, for colouring purposes. The blood of the hogs is manufactured into Prussian blue.

More than three-fourths of the exports are to the British colonies of South America and the West India Islands.

Few persons in the East can realise the size and fulness to which hogs grow in the Western States.

The following are specimens of hogs and lots of hogs killed in Cincinnati during this and the preceding season :

7	Hogs	averaging	720 lbs. each.
5	,, ...	,,	640 ,,
22	,, ...	,,	403 ,,
52	,, ...	,,	377 ,,
50	,, ...	,,	375 ,,

[Of these were nine—one litter weighing respectively 316, 444, 454, 452, 456, 516, 526, 532 pounds. Ten of them were over nineteen months old.]

320	Hogs	averaging	325 lbs. each.
957	,, ...	,,	305 ,,

The value of these manufacturing operations to Cincinnati consists in the vast amount of labour they require and create, and the circumstance that the great mass of that labour furnishes employment to thousands at precisely the very season when their regular avocations cannot be pursued. Thus there are perhaps 1,500 coopers engaged in and outside of the city making lard kegs, pork barrels and bacon hogsheads—the city coopers when they are not needed in stack barrels and other cooperage, and the country coopers, whose main occupation is farming during a season when the farmers require no labour at their hands. Thus there is another large body of hands, also agriculturists at the proper season, engaged in getting out staves and heading, and cutting hoop poles for the same business. Vast quantities of boxes of various descriptions are made for packing bacon for the Havanna and European markets. Lard is also packed to a very great extent for export in tin cases or boxes, the making of which furnishes extensive occupation to the tin-plate workers.

If we take further into view, that the slaughtering, wagoning—the pork-house labour—the rendering grease and lard oil—the stearine and soap factories, bristle dressing and kindred employments, supply abundant occupation to men, who in the spring are engaged in the manufacture and hauling of bricks, quarrying and hauling stone, cellar digging and walling, bricklaying, plastering and street-paving, with other employments, which in their very nature cease on the approach of winter, we can readily appreciate the importance of a business which supplies labour to the industry of probably 6,000 individuals, who but for its existence, would be earning little or nothing one-third of the year.

The United States' Census for 1840, gives 26,301,293 as the existing number of hogs at that date. The principal increase since is in the West, owing to the abundance of corn,—so that the whole number of hogs in the United States may now be safely estimated at 45,000,000. This is about the entire number assigned to Europe in McCulloch's Commercial Dictionary, and there has probably been no material increase there since, judging from the increasing want of the population in that quarter.

The number of hogs cut up in the valley of the Mississippi will reach this year to 1,500,000; of this, 28 per cent., or more than one quarter, is put up for market in Cincinnati.

THE FATAL EXPLOSION OF MR. DAKIN'S COFFEE-ROASTING APPARATUS.

We quote the following, from the *Times'* report of the first meeting of the Inquest on the body of Mr. Dakin :

"*John Jeffrey Dixon*, of East Temple-chambers, Fleet-street, slate agent, knew the deceased, and describes the apparatus made use of by him in roasting coffee. It was called "Dakin's Patent Silver Roasting Cylinder." The day before the accident, when the cylindrical oven was set up, and before it was bricked in, it was tried in my presence by Brown and Co.'s men, (and was stated by them to be at 500 degrees,) in order to see if there was any escape of steam. A small escape was perceived at two of the cells. I must here explain that these cells are plugged up when the oven is complete, and it was where the plug or breech is screwed into the cell that the escape of steam took place. The aperture was immediately closed by the men with a centre punch, and declared to be perfect, and ready to be fitted in. That was where the explosion took place. When the explosion took place, Mr. Dakin was standing in front of the oven—two or three feet from it. I was standing on his left hand, next but one to him, in a line with others. Some steam escaped from the cylinder, and we all saw there was something wrong. We stooped down to see where it came from, and the explosion instantly took place, and the room was filled with steam and dust, the top being blown off. In about two minutes, when the steam had subsided, I found deceased lying on the floor in front of the oven, quite dead. I saw a wound in his forehead, from which blood was running. In the course of the evening I examined the place of the accident, and found the top blown off and the brickwork blown away. The brick platform on which it was erected was also shattered, and the machinery thrown down. Part of the upper portion of the oven, on the right hand, was blown off about 8 or 9 inches in length, and 4 or 5 inches in depth, and the cells were exposed. This fracture was exactly opposite where deceased had been standing at the time. Two of the wrought-iron plugs had been forced out, one of which was picked up by the foreman of the patentees. The explosion took place at that part of the oven where I had seen steam escape the day before. The explosion was an awful and frightful one indeed. One of the workmen of the patentees was present at the time of the explosion, and had the management of the oven all the time."

It yet remains (May 9) to be clearly ascertained whether the accident was owing to any essential defect in the apparatus, or to some error or neglect on the part of the engi-

neers employed in applying it. We publish, in the meanwhile, the specification of the original patentee :

Specification.

The *first* of my improvements consists in forming cast-iron or other metallic tubes for containing or conveying fluids, in a heated or other state, in manner following: —To form a single tube, I take, in the first place, a pipe with overlap joint, formed of perforated block tin or sheet iron, and of diameter equal to the inside diameter of the intended tube. I coat this pipe, if of iron, with tin or other metal, to prevent oxidation, and then fill it with loam or compressed sand, to give it sufficient strength and firmness. I next fix this pipe in a proper cylindrical mould, of the usual construction, and pour cast-iron or other metal over and around it to the required thickness to form the intended tube. When the metal has cooled, and been cleansed of the loam or sand, it will be found to be perfectly incorporated with the perforated pipe, and to form with it a tube having a very uniform and smooth internal surface. Or, I sometimes prepare two such perforated tubes, of different diameters, but of equal lengths, so that one being fixed within the other in a proper mould, the inner tube being filled with compressed sand, and the outer one surrounded with the same material, melted metal may be poured between the two tubes, so as to unite therewith. By these means, tubes of any required dimensions may be formed, without the necessity of employing core bars in the usual manner.

My *second* improvement consists in the construction of tubular plates of cast iron, or other metals, such plates being of much greater lengths and breadths than of thickness, and having a series of parallel tubular passages running through them, (contiguous to each other,) either longitudinally or transversely. Each of the said passages is made to communicate with two or more cross tubes or passages of a larger kind, projecting either above or underneath the said plate, but all formed together in one casting. This I effect by connecting together any number of parallel cores of the usual construction, with two or more cross cores, their extremities being supported in proper casting frames or boxes of the usual kind, and melted metal cast over them to the required thickness, which will be regulated by the mould or pattern used. On the core bars being afterwards withdrawn, the apertures at the end of the main passages are then tapped, and screwed, and plugged up, so as to render the same steam and water tight. The open ends of the cross passages may have flanges cast to them, with bolt holes formed thereon, so as to facilitate their union with other tubular plates, or for allowing plates of metal, corresponding with the said flanges, to be screwed or bolted thereto, by means of nuts and bolts, with rings or washers placed between them, either for stopping up their end apertures, or for uniting pipes thereto for supplying the passages with steam or other fluids for heating the same, as hereafter described. In heating these plates with very high-pressure steam, I propose to make the end openings of these cross passages of a circular shape, with conical or other shaped circular cavities around or within the same, and with corresponding protuberances on the flanged plates, and then to have these ground accurately together, metal to metal, and afterwards tightened as required, by nuts and bolts through the flanges thereof, as before described. Or metallic rings may be used, provided there are circular grooves turned and ground accurately to fit them; but I generally prefer dispensing altogether with the flanges and nuts and bolts, and in lieu thereof to have the circular end openings of the cross passages tapped and screwed, so as to allow of screwed metal plugs being inserted therein, which can be then screwed into them, or taken out at pleasure; or the ends of pipes, properly screwed, may be attached to the end openings of the cross passages, for the purpose of conveying steam or other heated vapours or liquids for heating the same. I further propose to let the cores by which the main series of passages are formed, terminate in one of the cross passages, instead of passing entirely through the plates, as before mentioned; which I effect by causing the end of the cores to rest upon and be united with one of the cores of the cross passages, whereby the expense of screwing and plugging up the apertures on one side of the tubular plates is saved. I also propose, instead of placing the cross passages underneath the said plates, as before described, to form them of the same size, and in the same plane, with the main series of cells, which may be effected by causing the main series of cores to terminate in the centre of one of the cross cores, by means of pins or wires fixed in the ends of the main cores, and supported in holes formed in the cross core, and then forming the opposite cross passage by means of short cores placed between each pair of the main series of cores, and extending outside thereof, so as to form, when the casting has been made, and the core-bars withdrawn, one continuous cross passage. By this method of employing short cores, the number of cross passages may be increased to any extent calcu-

lated to promote a more perfect and uniform distribution and circulation of the fluids employed for heating the same. I also propose to form the main series of passages at such distances apart that each of the ribs of metal between them shall at all times be of greater thickness than the metal above or below the same, so that, in case of the plates bursting from excessive pressure, the fracture shall be thereby caused to take place along the top or bottom of the tubular passages in the direction thereof.

My *third* improvement relates also to the formation of tubular metallic plates. This I effect by connecting together any number of perfect iron tubes (though, in some cases, tubes of other metal may be employed), so as to form a parallel series with two or more other tubes running at right angles transversely thereto, and having conical or other shaped openings formed therein, suitable for receiving the ends of such parallel series, which ends are made to fit accurately in the said openings, and have collars or grooves formed therein, so that they may be retained firmly in their places by wires coiled around them and the transverse tubes. The ends of these transverse tubes are carried considerably beyond the main series, so as to admit of such ends being imbedded in sand or loam, or otherwise supported when placed within iron frames or boxes adapted for the casting of metals; so that iron or other metals, in a state of fusion, being poured over the said tubes so placed, tubular plates of any required thickness and other dimensions may be formed, according to any given model or pattern. It is advisable that these iron tubes, previous to having metal cast over them, should be coated with tin or other metals suitable for preventing the oxidation thereof.

My *fourth* improvement has also relation to tubular plates. Instead of using core bars covered with loam, or perfect tubes, as last before described, of strength sufficient to resist the pressure of the fluid metal in the process of casting, I bend thin strips of wrought iron plate, coated with tin, into a tubular form by bringing their longitudinal edges together, and forming a lapped joint, or by drawing such thin strips of coated iron, or iron plate, through apertures, according to the size and form of the tubular cavities required, by means of a draw bench; as is commonly practised for making copper and other tubes. These thin strips of coated iron have previously a great number of small holes punched through them (so as to allow the air to pass from within at the time of casting) and are then filled with sand or other suitable material compressed to a degree sufficient to give strength and firmness to the tubes so formed, in a similar manner as in the making of tubes for the conveyance of fluids as before mentioned. The tubes are then placed in a series, and united with transverse tubes of a similar kind, into which their extremities are made to enter, through corresponding apertures formed therein; which transverse tubes are then also filled with compressed sand or other material. Melted metal is finally cast over the whole, as before described; and after they have been thus formed into plates, the ends of the parallel series of tubes, which protrude into the transverse tubes may be cut away by means of a drill-cutter, and the sand, or other material, used for filling the tubes, cleared out from the tubular cavities by subjecting the plates to the effects of percussion in a proper position. By this new mode of casting (as in the previously described method of forming tubular plates by casting metals over perfect tubes) there will be no openings to be plugged up (as in the first described method with core bars), and thereby a considerable saving of expense in that particular part of their manufacture will be effected. But instead of forming these tubes so thin as block tin, and into a tubular shape by means of a draw bench, as before stated, I sometimes make them of thick wrought iron plate, equal in strength to the perfect tubes before described; I then fill them with sand, previous to casting, to prevent the melted metal running through the slits left where the edges meet together. These tubes I propose forming into shape by passing properly cut pieces of sheet iron through grooved rollers adapted for the purpose, such iron being first made red hot.

My *fifth* improvement consists in forming circular plates, with a series of tubular cavities within them. These plates may be formed by means of a series of cores radiating from the centre to the circumference, and then being united together by a series of short cores, or curvilinear tubes, filled with sand, as before described, and a circular box at the centre, into which the ends of the core bars may penetrate, and after casting be withdrawn; then the sand being cleared out the apertures left may be tapped, screwed and plugged up, as before described; there being proper openings with pipes communicating with the circular passages, to allow of the admission of the vapours or liquids employed for heating the same. Or these cavities may be formed entirely with tubes, or tubes filled with sand (according to the previously described methods of forming tubular plates); in either of which cases the plugging may be avoided, or the main series of cells may be formed by tubes

with metal cast over them in concentric circles, and united by others radiating from the centre, or in any other form, so that a series of tubular cavities are united together by other cavities, so as to form one vessel of capacity for containing steam or other vapours or liquids for communicating heat thereto.

My *sixth* improvement relates to wrought iron cellular plates. I roll two sheets of iron so as to leave a series of projecting parallel ribs on one side thereof of sufficient width to allow of cavities or mortices, of a dove-tailed shape, being formed therein by planing machines, and in each of the plates exactly opposite each other, so that tenon-shaped bars, or such as are formed to correspond with the said cavities, may be inserted therein, so as to bind the two plates firmly together. Or the ribs upon one plate may be planed, so as to slide in the cavities of the other formed to receive them; other cavities being made therein for containing the fluids by which they are heated; which plates may then be welded together around their edges by having the ends of the ribs cut away, so as to allow of square bars of iron being placed between the plates, forming a frame, to which the edges are welded by hand at a common forge, so as to render the whole perfectly steam and water-tight. Proper cross passages may then be drilled through the same, to unite all the main passages together. Another mode of forming wrought iron plates consists in placing plates formed with ribs one over the other at a proper distance, in a furnace, so as to give them a welding heat, and bringing their ribbed surfaces suddenly together, and passing them rapidly between rollers regulated so as to give the requisite pressure for welding the ribs together; the unwelded ends being afterwards prepared and welded to flat bars of iron, and afterwards proper cross passages drilled, as before described.

GREAT SUSPENSION BRIDGE AT THE FALLS OF NIAGARA.

(From the *Toronto Colonist.*)

This day, the 13th of March, 1848, will for ever be remembered by all who witnessed the awful and sublime spectacle of the crossing of the first car, sustained by a wire cable; the car was capable of holding four persons. It was understood that Mrs. Ellett, the lady of the distinguished engineer who has undertaken the construction of the bridge, had determined to accompany her husband; but in consequence of the cold, with some snow, she was prevailed on to stand among the interested spectators who had the high gratification to behold the grandest scene ever witnessed; when we take into consideration the position of the intended bridge being in view of the great Falls, on one side, and the whirlpool on the other, while the elevation of the car was 250 feet above the awful rushing river. The wire cable was only one inch diameter, so that it appeared but a thread in our eyes.

A little after eleven o'clock Mr. Ellett took his seat alone in the car. Being among the spectators on the Canada side, I can say, in justice to the feelings of all present, a breathless anxiety filled every heart, and when he reached about half way our fears gave way for his safety, and a shout of joy broke forth from all which overpowered (in our ears) the thunder of the great falls, and was re-echoed from the opposite side. On arrival at the stand, three warm-hearted cheers (cold as the day was), awaited the intrepid and enterprising gentleman; and, on his returning, three hearty cheers, and one for his lady, as her determination to accompany her husband was known.

The cool, determined aspect of Mr. Ellett was observed by all. Truly we live in a wondrous age—to see a gentleman floating through the air, 250 feet above the waters, on wires such as are used in electricity; when we reflect upon it our imagination is raised so, that the mind regulated by the experience of past days is lost in astonishment. It was indeed a proud spectacle for all, but especially for those who promoted and have taken an interest in the construction of the bridge; all surmises are put to flight as to the practicability of it, by this day's exhibition. The work is progressing very rapidly, and no doubt is entertained of its proving highly profitable to those who have had the good fortune to invest their funds in the splendid undertaking.

It is the first attempt of the kind, on this mighty outlet of the inland seas to the Atlantic Ocean, and Mr. Ellett must feel gratification and commendable pride that he is the first man who ever crossed in a carriage through the air, on wire, from one empire to another—thereby, it is to be hoped, leading to a happy, prosperous, generous, and reciprocal union, a firm chain of friendship between mother and daughter.

IGNITION OF SPONGY PLATINUM.

Sir, — Mr. Bentley, whose letter is published in your last, seems totally to forget, in his explanation of the phenomena caused by hydrogen and spongy

platinum, that if water be formed by the oxygen + hydrogen, there would certainly be a counteracting influence which would render it impossible that the platinum should become red hot.

Even supposing that the gases did not in themselves produce water, and thereby become annihilated, yet the presence of watery vapour alone would prevent incandescence.

Dr. Lardner, it is true, does not account for the phenomenon; certainly not, for he was well aware of the truth of my argument. I am, Sir, yours, &c.,

A PRACTICAL CHEMIST.

May 8, 1848.

MASON'S SELF-ACTING MULE.

[From American Patentee's Specification in the *Franklin Journal.*]

The motions of the mule may be divided into three series, which are subdivided in the action of the apparatus. The first series consists in the drawing out of the carriage, the revolving of the drawer rollers, and the whirling of the spindles; by means of which series of motions the rovings are drawn out and the threads spun and twisted. The second series consists of backing off, as it is termed; that is, turning the spindles the reverse direction, to uncoil the threads from the points of the spindles to the cops, and turning down or depressing the front faller; at the same time, to place all the parts in a proper condition for the third series of motions, which consists of putting or running in the carriage, winding on the yarn or threads, by giving a varying motion to the spindles corresponding to the form and size of the cops, and operating the faller to give the proper shape to the cops.

The first series of motions is regular. The carriage is drawn out by a regular motion, effected by a train of wheels from the driving pulley to a line shaft, which carries endless chains connected with the carriage at different parts of its length to insure steadiness of motion. During this, the draw rollers are rotated to give out the staple as it is spun by another train of wheels, deriving motion from the same source as the preceding, and in manner substantially similar to other mules; and, at the same time, the spindles are whirled or rotated by a band, receiving motion from a pulley on the shaft of the driving pulley, as in other mules. This completes the first series of motions, in which I claim nothing new.

At the end of the first series of motions, the threads that have been spun are coiled on the spindles from the cops to their points; it is therefore necessary to uncoil them, (called "backing,") preparatory to winding on, and at the same time, to depress the front faller, to place it in a proper position for winding on. The second series of motions effects these purposes, and the various parts of the mechanism are put in a proper condition to effect this by the momentum of the moving parts at the end of the first series of motions. This constitutes the first part of my invention. As the carriage approaches the end of the out motion, the driving belt is shifted from the first driving pulley to a loose pulley by the side of it, to permit the momentum of the moving parts to complete the movements; and so soon as these are accomplished, a balance weight is carried beyond the vertical line, and falls over, which shifts the belt from the loose pulley to a second fast pulley on the same shaft with the others; at the same time, the trains of wheels that operate the carriage and the draw-rollers are liberated by the shifting of a clutch, and at the same time, a friction clutch is brought into action, thereby connecting the band that drives the spindles with a sliding rack, (called the "top-sliding rack,") which, in consequence of this connection, is carried by the momentum of the spindles sufficiently far in one direction to give by its return the required motion to the spindles in the reverse direction, to uncoil the threads from the upper part of the spindles. Whilst the rack is thus moved, the second fast pulley sets in motion, by a train of wheels, a crank pin that works in a slot in a connecting rod, and this crank pin, when set in motion, is a little below a line passing through the connecting rod and the axis o fmotion, so that the crank pin moves a short distance before it begins to move the connecting rod; this period of time is sufficient to permit the momentum of the spindles (as above stated) to draw the sliding rack to the distance required, to be in a condition, by its return movement, to give the "backing-off" motion to the spindles. The crank pin, then, in making a semi-revolution, carries the connecting rod with it; and this being in connection with the lever of a rock shaft, provided with a toothed pulley, around which passes a chain attached to the end of the sliding rack, draws it (the rack) for a short distance in a reverse direction, and thus causes it to give the backing-off motion to the spindles, to uncoil the threads, at the same time depressing the front faller to bring the threads in a proper position for winding on; this latter being effected by having one end of the shaper or coping rail jointed to a lever on the rock

shaft above mentioned. The chain attached to the rack, and which communicates motion to it, is kept tight by being passed over a pulley and having a weight suspended to it. When the top-sliding rack is carried forward by the momentum of the spindles, at the end of the first series of motions it is gradually arrested, and with it the spindles, by means of a spring brake of a peculiar construction, viz.:—On the rock shaft there is a bent lever, to one end of which is connected a helical spring, also attached to an arm jointed to the other end of the bent lever; and by the side of and attached to the toothed wheel, around which passes the chain on the end of the sliding rack, and which turns freely on the rock shaft, there is a ratchet wheel, and by the side of it a cam-plate provided with a hand or catch, by means of which the ratchet and toothed wheels are carried around, when the cam-plate is carried around by the action of the spring brake on the cam-form of its periphery: and when this has been carried far enough round, the catch is liberated, to permit the return of the parts, by means of an arm or lever jointed to one end of the bent lever, which is made to lift the catch from the teeth of the ratchet wheel. As the cops increase in diameter, it is evident that the backing-off motion must be diminished, and that this is effected by making the connecting rod above mentioned in two parts, the first connected by one end (as above stated) with the crank pin which actuates it, and which works in a slot to give motion to the rod in one direction only, (the crank being then at liberty to turn without imparting any motion longitudinally to the rod,) and the other end being jointed to a curved arm, that vibrates on a steel pin, and the other part of the connecting rod is jointed to the arm of the rock shaft, and to a slide that works in a curved groove in the vibrating arm, so that, as this slide is moved from or towards the axis of motion of the arm, the rock shaft will be vibrated more or less; and this slide is moved in or out by being in connection with the mechanism that operates the motions of the coping rail, and which, therefore, will be described under the third series. At the end of the backing-off motion, the vibrating arm of the connecting rod is hooked and held by a catch until the carriage is run up, and then liberated to permit the parts to resume their appropriate positions preparatory to a repetition of the operations.

At the end of the second series of motions the third series of motions commences, and these constitute the second part of my invention. The carriage is run in by a crank motion, which has the effect to gradually start it from a state of rest and accelerate its motion to the middle of its course, and then gradually diminish its motion until it is brought to a state of rest; thus avoiding all tendency to break the threads consequent upon all sudden motions. This is effected in the following manner, viz.:—When the shipping lever is operated at the end of the first series of motions, a clutch on a shaft carried by a second fast pulley is shifted; and as this clutch has but one tooth, the shaft is thereby permitted to make part of a revolution, during which the second series of operations takes place before it (the clutch) begins to act, and then it communicates motion to a large cog-wheel provided with a crank-pin, that actuates a connecting-rod jointed to a rack, (below the top-sliding rack above described,) the teeth of which take into the teeth of a pinion on the shaft of one of the train of wheels that communicates motion to the carriage, thereby imparting the desired movement. The winding on of the yarn during the running in of the carriage is effected by the top sliding rack, which for this purpose is carried by the rack just described, by means of such connections as admit of modifying the motions of the top sliding rack, which drives the spindles in winding on. Motion is communicated from the bottom to the top rack, in the following manner:—On the end of the lower rack, and by the side of it, there is a stud pin on which turns a scroll cam, and to that part of its periphery which is nearest the axis is attached one end of a chain, which passes from thence around a roller that turns on a stud-pin at the side of the lower rack, and is then carried back and attached by a short arm to the top sliding rack, so that when the lower rack slides, the top rack will move with it, provided the scroll cam remains immoveable on its axis; but the motion of the top rack, during each operation, must have a motion accelerated relatively to that of the lower rack, to increase the rotation of the spindles, as the threads are wound round on a gradually diminishing diameter of the conical form of the cops. This is effected by causing the scroll cam to turn on its axis during the motion of the rack, by having a wheel attached to and turning with it, to the periphery of which is attached one end of a chain that passes round it, and is attached by the other end to another part of the machine, so that, if this part of the attachment remains fixed, a regular accelerated motion will be given to the top rack relatively to the motion of the lower rack, and necessarily the spindles will have their rotation accelerated relatively to the motion

of the carriage. These relative motions of the two racks, as described, are such as are required after the base of the cops has been formed, for then the threads are wound regularly on a cone; but in forming the base of the cops, the first winding is on the naked spindles, at which time the motion of the spindles should correspond with that of the carriage; and from the commencement until the base is formed, the accelerated motion should be gradually brought into play to give the conical form to the cops. This is effected by having the chain that winds on the wheel that turns with the scroll cam attached to a slide that works on a screw in a vibrating arm, the outer end of which is jointed to another arm of equal length that turns on the end of the stud on which the scroll cam and wheel turn, so that when the slide is at the lower end of the arm—the two arms being of equal length—the motion of the wheel with the rack will not cause it to wind up the chain, but, as the slide is drawn up towards the axis of vibration of the arm, one end of the chain will necessarily move through a less space than the other, and thus cause the wheel with the scroll cam attached thereto to turn on its axis, and thus to vary the motion of the top rack, and thereby adapt the motion of the spindles to the varying diameter of the base of the cops. The screw in the vibrating arm that carries this slide is in connection, by means of appropriate cog-wheels, with a horizontal ratchet wheel, which is free to move when the arm vibrates in one direction, but held by the hand or catch when the arm vibrates in the reverse direction, for the purpose of turning the screw to move the slide; and this hand or catch is governed by an apparatus called a butterfly, which is acted upon by an arm from the counter faller when the tension of the threads is too great, and thus throws the hand into the teeth of the wheel, that the vibration of the arm shall operate the slide, the hand or catch being disengaged at each running out of the carriage. The last of the third series of motions is the operation of the coping rail for operating the faller, which, being essentially similar to others, needs no special notice here.

At the end of the running-in motion of the carriage, a pin, on an arm projecting from the shaft of the crank that operates the under rack, liberates the catch that holds the connecting rod, by which the backing-off motion is effected; and so soon as it is liberated, the weight of the machinery attached draws it back; and to prevent any sudden jar by this operation, the crank pin which operates the connecting rod in one direction is so governed in its revolutions as to be nearly a semi-revolution from its point of departure at the commencement of the backing-off operation; so that the force required for carrying it back to this position is sufficient to ease off the motion of the returning parts. This crank pin is held in the position just indicated by a brake within the second fast pulley, and this brake is connected, by a joint link and lever, with the arm of the connecting rod of the backing-off apparatus, which, when drawn back, forces the brake in contact with the pulley, and arrests the train of wheels and this crank pin in their appropriate place.

When finishing the cops, it is important to wind the threads on tight at the point, particularly as the upper ends of the spindles are tapering. This is effected by forming the connection between the chain and the end of the top sliding rack by means of a vibrating frame, from which projects another arm, that has a chain jointed to it extending to and winding on an arbor, which arbor has a ratchet-wheel on it, which is carried a part of a revolution at each operation of the mule by a hand on the arm of the connecting rod of the backing-off motion; and this auxiliary chain is of such length that it continues to be wound upon the arbor without affecting the operations of any part of the machinery until the cops are nearly completed, and then it becomes so short as to be brought in contact with a permanent arm towards the end of the winding-on operation; and when thus brought in contact with this arm, it suddenly shortens the chain that forms the connection between the two racks, and necessarily increases the rotation of the spindles, which, as a necessary consequence, draws the threads tighter on the spindles.

Claims.—1st. The disconnecting of the mechanism employed in running out the carriage and turning the draw rollers from the mechanism, which gives the whirling or spinning motion to the spindles when the driving power is shifted from these, the first series of motions, to enable the spindles to continue their motion by inertia, independent of the other motions, by means of the clutch-box, (or its equivalent,) which forms the connection between the three movements constituting the first series of motions, whereby the momentum of the spindles can be employed for preparing the parts for the backing-off motion, substantially as described.

2nd. The method of preparing the parts for the backing-off motion, by means of the momentum of the spindles, by connecting them with the backing-off apparatus by

means of the friction-clutch, or any equivalent therefor, substantially as described.

3rd. The backing-off apparatus, consisting of the combination of the top sliding rack, which communicates motion to the spindles; the rocking shaft, with its cam and spring brake, and other appendages, and the connecting rod, operated by the crank; all substantially as described.

4th. The method of decreasing the backing-off motion to correspond with the increased length of the cops, by means of the slide in the intermediate arm of the connecting rod (between the two sections of the connecting rod,) by means of which the rocking motion of the rock shaft is gradually decreased, substantially as described.

5th. Combining the train of wheels which actuate the backing-off motion of the carriage by means of a clutch, substantially as herein described, which admits of the necessary backing-off motion before the tooth of the clutch starts the carriage, whether this be effected by a clutch, or by any other means substantially the same.

6th. Running-in the carriage by means of a crank motion, which actuates a sliding rack that communicates the desired motion to the carriage, so as to start and arrest it gradually, substantially as described, to avoid any sudden strain or jar upon the threads.

FIELDER'S PATENT IMPROVEMENTS IN IRON BEAMS OR GIRDERS.

[Patent dated November 9, 1847. Patentee, Henry Fielder, of Maida Vale. Specification enrolled May 9, 1848.]

The improvements described in this specification relate, Firstly—To the construction of beams or girders, composed partly of malleable iron and of cast iron, which the patentee terms "compound girders or beams." The lower or tension flanges are made wholly or partly of malleable iron, while the centre ribs and upper or crushing flanges are wholly or partly of cast iron, according to the duties they may have to perform; for instance, the lower flange may be made of, or strengthened by the addition of, malleable iron, and the centre rib and upper flange remain of cast-iron; or, the upper and lower flanges may be of, or strengthened by the addition of, malleable iron, united to the centre cast-iron rib, and further strengthened, when exposed to vibration, by angle iron; or, the perpendicular ribs may be also composed of malleable iron, when exposed to violent concussions. The malleable iron is united to the cast iron by "hot riveting," and, in all cases, in such proportion that it shall be able to support, alone, the estimated weight to which the whole girder may be subjected, and so prove efficient in case of fracture of the cast-iron portion.

Secondly—In the application of the preceding principle of construction to the strengthening or repairing of existing beams or girders, with such variation of detail as the particular case may suggest.

Thirdly—To the construction of beams or girders composed entirely of malleable iron, in which case the flanges are united to the centre rib by angle iron, the coupling-joints headed, and the whole fastened together by hot riveting.

HEATON'S PATENT IMPROVEMENTS IN LOCOMOTIVE ENGINES.

[Patent dated Nov. 9, 1847. Patentee, George Heaton, of Birmingham, engineer. Specification enrolled May 9, 1848.]

These improvements consist in the application of counter-balance weights, moving in an opposite direction to the pistons of the steam cylinders, in order to prevent the oscillation and uneasy motion to which locomotive engines have hitherto been subjected.

The mode of applying these counter-balance weights preferred by the patentee, but to which he does not confine himself, is as follows:—On each end of the axle of the driving wheels is placed a crank, to which is united a connecting-rod, attached at the other end to the counter-balance weight, which is suspended between two rods, so as to swing readily to and fro, or held between fixed guide-rods, to admit of its sliding easily. The position and arrangement of the counter-balance weight in respect to the pistons, should be such, that they should always move in the direction opposed to that of the latter; and should, moreover, be equal in weight to that of the pistons and gear for working them.

Watch Chains.—A small watch-key chain, six inches in length, contains, ordinarily, 42 rivets and 63 links in every inch—in all, 630 pieces; and yet the entire chain will weigh only one grain and three quarters.

INQUIRIES AND ANSWERS TO INQUIRIES.

Iron and Steel "Physic."—"A Constant Reader."—The "Physic," or mixture, was the subject of a patent granted to Messrs. Southall and Crudginton of Feb. 8, 1844, for "improvements in the manufacture of iron and steel." It is composed of sulphur and nitre, with borax, soda or potash, and alum, which are broken into a granular state and made up into parcels of about one and a half pounds each,—the proportion of the constituent materials, one to another, being equal parts by weight, of sulphur, nitre, borax and alum, to one-half part of soda or potash. The

mixture is incorporated with the melted iron. One parcel is considered to be a sufficient "dose" for every four cwt. of iron in the puddling furnace.

Damp Walls.—"Richard Moore."—Mr. Murray recommends, when damp walls proceed from deliquescence, that they should be washed with a strong solution of alum, which converts the deliquescent salt into an efflorescent one.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Lewis Dunbar Brodie Gordon, of Abingdon-street, Westminster, civil engineer, for an improvement or improvements in railways. May 9; six months.

William M'Lardy, of Salford, Manager, and Joseph Lewis, of the same place, machine-maker, for certain improvements in machinery or apparatus applicable to the preparation and spinning of cotton, wool, silk, flax, and other fibrous substances. May 9; six months.

Richard Laming, of Clichy la Garonne, France, for an improvement or improvements in the manufacture of oxalic acid. May 9; six months.

Edward Haigh, of Wakefield, plumber and manager of the Wakefield Waterworks Company, for an invention for measuring water or any other fluid. May 9; six months.

Charles Hancock, of Brompton, Middlesex, for certain improved preparations and compounds of gutta percha, and certain improvements in the manufacture of articles and fabrics composed of gutta percha, alone and in combination with other substances. May 11; six months.

Thomas Wressell, of Tooting, Surrey, watchmaker, and Richard Clark, of the Strand, Westminster, lamp manufacturer, for improvements in chronometers, clocks, watches, or other timekeepers. May 11; six months.

Vincent Price, of Wardour-street, Soho, Middlesex, machinist, for certain new or improved mechanical arrangements for obtaining and applying motive power. May 11; six months.

George Armstrong, of Newcastle-upon-Tyne, engineer, for an improved water-pressure engine. May 11; six months.

Mark Smith, of Heywood, Lancashire, powerloom maker, for certain improvements in looms for weaving. May 11; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
May 8	1442	Thomas Parker	Peterborough	Portable box oven.
,,	1443	John Crichton	Glasgow, machinist	Automatic water-feeder gauge, and alarm for Steam boilers.
,,	1444	George Simpson	Glasgow	Duplex straight-edge protractor.
,,	1445	Barrett Exall, and Andrews	Katesgrove Iron-works, Reading, Berks	Haymaking machine.
9	1336	John Pinchback	Atherstone	Bee-hive.
10	1447	Thomas Stokes, and Chas. J. Atkinson	Birmingham	The globular coal-vase.

CONTENTS OF THIS NUMBER.

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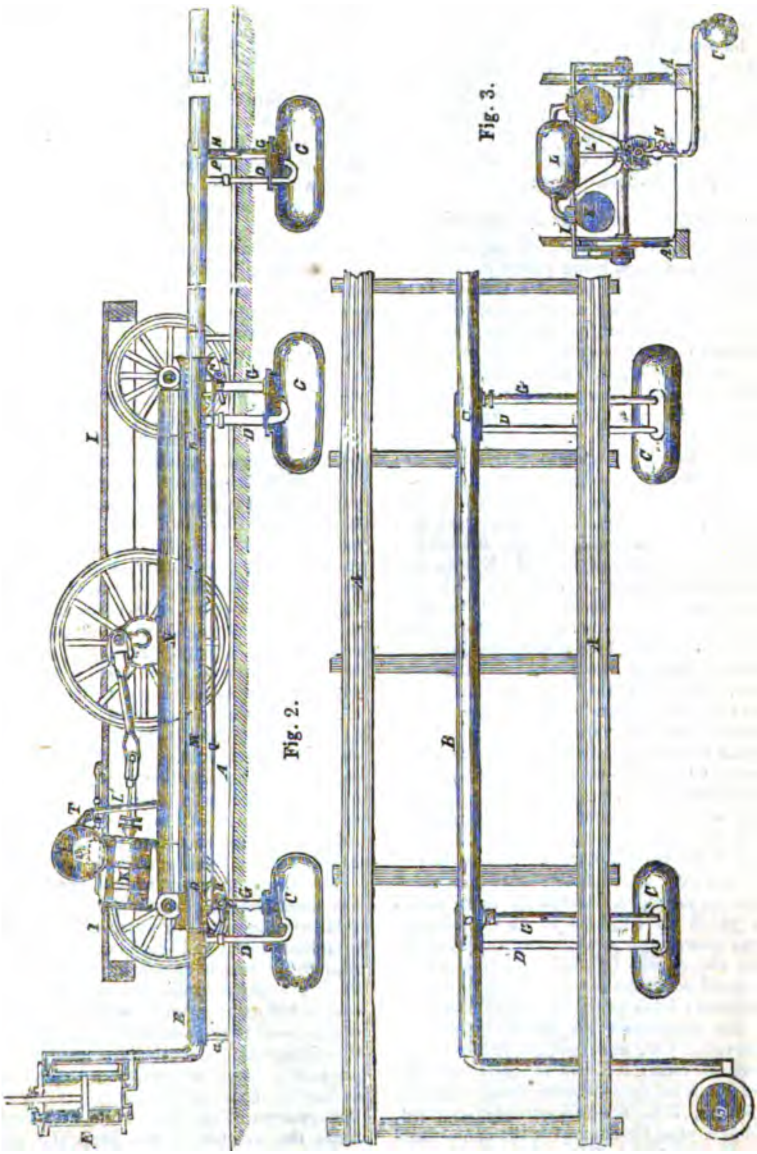
Edited by J. C. Robertson, 166, Fleet-street.

FELL'S NEW SYSTEM OF RAILWAY PROPULSION.

Fig. 1.



FELL'S NEW SYSTEM OF RAILWAY PROPULSION.

[Patent dated October 7, 1847. Patentees, Richard and James Fell, of Winchester-street, City of London. Specification enrolled April, 1848.]

The new railway system propounded by the Messrs. Fell consists in certain peculiar methods of combining stationary with locomotive engine power—the stationary power to be derived from steam, the locomotive from compressed or rarefied air. It exhibits great ingenuity, and a model of it, which we have seen, works well. The patentees show, first, how their system may be worked with compressed air, and next with rarefied air. We shall give both plans:

I. *The Compressed Air Arrangement.*

Fig. 1 is an elevation, and fig. 2 a plan (both these figures being partly in section,) and fig. 3 a cross section of a portion of a line of railway, fitted with the apparatus or machinery suitable for carrying out our invention on the air-compressing principle. AA, are the rails; B, is an air main or pipe, which occupies a central position between the rails, AA, and is securely fixed to the permanent way upon which the rails are laid, by means of upright standards, *aa*; CC, are two of a series of compressed air reservoirs, which are placed alongside the line of rails at equal distances from one another, and communicate with the central pipe, B, by smaller pipes, DD; E is an air-compressing cylinder, worked by a stationary steam engine (not shown in the figures,) for which water power may be substituted where convenient, by which atmospheric air is forced through the pipe, B, and smaller pipes, DD, into the vessels, CC. Any reflux of the air from the reservoirs, CC, is prevented by the valves, FF. GG are a second set of pipes, which pass from the vessels, CC, up through, but without communicating with the pipe, B, and terminate flush with the outside of that pipe; these pipes being open at bottom to the compressed air vessels, C, and open at top to the external atmosphere; HH are stop-cocks on the pipes, GG, the levers for opening which are weighted so as to keep the cocks closed, and prevent any escape of air from the vessels, CC, till they (the levers) are acted on in the manner to be presently explained; I I is an engine, which is worked by the compressed air supplied from the reservoirs, CC, and propels the carriages along the rails; KK are the driving cylinders; L is an antechamber, from which the cylinders, KK, are immediately supplied, and L′ a pipe for conveying the compressed air from the vessels, CC, to the antechamber, L. The engine is nearly similar in every respect to a locomotive engine, except only that compressed air is employed instead of steam to move the pistons within the cylinders. The requisite communication between the pipe, L′, and the compressed air vessels, CC, is thus effected:

A long slide-valve or slipper-bar, M, is horizontally attached to the carriage of the engine. Into one chamber, N, of this valve, the pipe, L′, is inserted at top, while the lower side of the same chamber is perforated at bottom with a continuous line of holes, over which there are fixed, valves *bb*, by which air may enter from beneath, but is prevented from again escaping in any other direction than the pipe, L. OO is a portion of the slipper-bar or valve, which embraces the pipe, B, for about three-fourths of its whole circumference, leaving a continuous slot on the lower side from the one end to the other, so that the upright standards, *aa*, may present no impediment to the valve or slipper-bar travelling along the pipe, B. The lower portion, OO, of the slipper-bar is of such a size as just to allow it to pass freely over certain enlargements on the pipe, B, which enlargements take place at those parts where the pipes, GG, pass up through it, so that at those parts the slipper-bar or valve fits nearly air-tight upon the upper surface of the pipe, B, and thereby admits of compressed air passing from the pipes, GG, into the hollow chamber, N, of the slipper-bar through the valves, *bb*, with but little waste from leakage, if any. From the chamber, N, the compressed air is then at once conveyed to the antechamber, L, by the pipe, L′. T, is a stop-cock, by which the driver has the power thus transmitted completely under his command. The length of the slipper-bar should always be greater than the distance between the pipes, GG, so that at whatever part of the line the engine is stopped, it may be within the range of one or other of the compressed air vessels, CC.

The weighted levers, which have been before described as governing the stop-cocks, HH, terminate at their upper end in rings or projections, PP; and Q is a bar affixed to the slipper-bar which comes into contact with these projecting rings, PP, and opens the cocks, HH, successively, as the slipper-bar comes over the pipes, GG; thus allowing the compressed air to flow through the pipes, GG, from the compressed air vessels, during the time the engine is passing over that portion of the line, while at all other times the weighted levers keep the cocks shut as has before been explained.

In fig. 4 we have shown certain additions

Fig. 4.

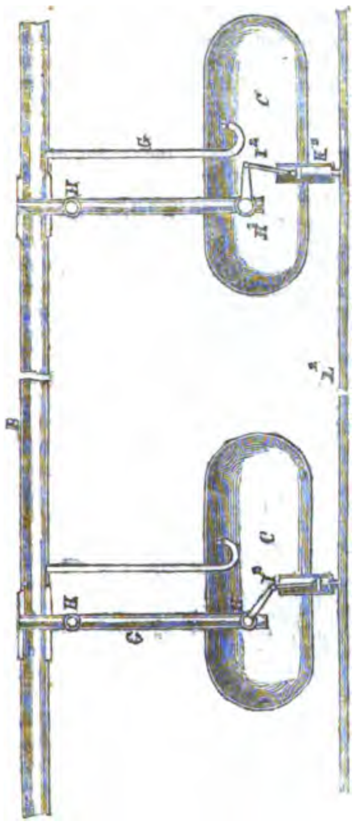
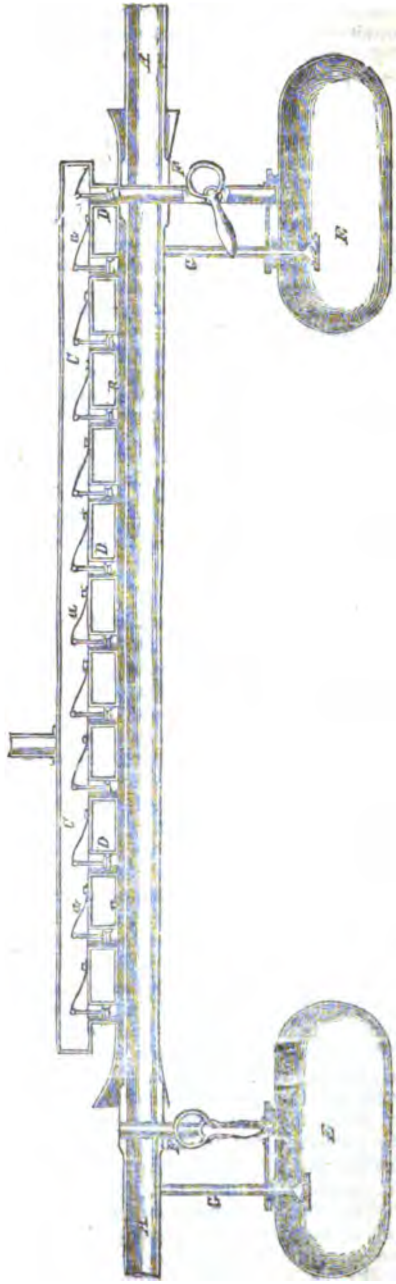


Fig. 5.



which may be made to the preceding arrangements, in order the better to secure the due action of the pipes, GG, in conveying the compressed air from the vessels, CC; B, is the central air main upon which the slipper bar slides; GG, the compressed air pipes as before, and HH the balanced lever stop-cocks; H^2H^2, are other stop-cocks upon the pipes, GG, which are placed inside of the vessels, CC, and opened and closed by levers, which are connected at their outer ends to the piston-rods, I^2I^2, which move in the cylinders, K^2K^2; L^2, is a pipe connected with the cylinder, K^2K^2, of the whole line. When the air in the pipe, L^2, is compressed to a greater extent than that of the air inside the vessels, CC, (which may be effected by means of a condensing air-pump, not shown in the drawing,) then the pistons of the cylinders, K^2K^2, are forced up and open the cocks H^2H^2. When, however, it is desirable that

the cocks, H^2H^2, should be closed, the compressed air in the pipe, L^2, is allowed to escape, upon which the compressed air in the vessels, CC, will force down the pistons of the cylinders, K^2K^2, and thereby open the stop cocks.

II. *The Rarefied Air Arrangement.*

The modifications requisite for adapting the machinery before described to be worked by the rarefaction instead of compressed air, are represented in fig. 5. The only material difference consists in the disposition of the valves, which are all arranged to act in the reverse direction to those employed for compressed air. A, is the tube central to the line of rail; B, the slipper-bar; C, an intermediate chamber in which the valves, DDD, forming the communication between the engine and the exhausted receivers, EE, are placed. The last of these valves to the extreme right is represented as being immediately over the pipe, F, which opens into the exhausted receiver, and therefore being at that instant of time in action, the valves are held upon their seats by the springs, *aaa*. GG, are the pipes through which the air is exhausted from the receivers, EE.

CAPTAIN ERICSSON'S AND MR. SAM. HALL'S SYSTEMS OF CONDENSATION.

Sir,—In the last number of your work (No. 1291,) I have noticed a long extract from the *Franklin Journal*, consisting of a report upon Captain Ericsson's apparatus for affording a continuous supply of fresh water to the boilers of marine engines, upon which I beg to be permitted to offer a few observations.

After some remarks on the importance of the object sought to be obtained, the report notices Mr. S. Hall's contrivance for the same object, which it declares to be a failure, and then proceeds to describe Captain Ericsson's, which it denominates "the new method." After an attentive perusal of the report, I can discover nothing in which this "new method" differs from that successfully carried out in practice by Mr. Hall, more than ten years ago, the novelties consisting merely of deviations from the arrangement of the parts adopted by Mr. Hall, which deviations cannot possibly have the effect of obviating the disadvantages imputed to Mr. Hall's arrangement, and which only become important, inasmuch as they are changes for the worse. In Mr. Hall's, as in the new method, I need scarcely tell your readers, that the steam from the cylinders is condensed by contact with metallic pipes exposed to a current of cold water, and that the waste from leakage at joints, stuffing-boxes, &c., is replaced by distillation from sea-water *in vacuo;* but whereas Mr. Hall employs pipes of ¾-inches diameter, in the "new method" the pipes are of "*two inches bore;*" and whilst Mr. Hall (not invariably, but where circumstances permit) prefers to place his pipes *upright*, in the "new method" *they incline slightly from the horizontal.* With respect to the *distillation in vacuo*, it might be inferred from the report, that it was peculiar to the "new method," instead of having originated with Mr. Hall (as far as regards this particular application of it) many years ago, and forming one of the subjects of one of his earliest patents for improvements in steam engines. The difference between the two plans is, that, whereas Mr. Hall's still is inserted in or connected with the boiler, in the new method the still is in connection with the two ends of the cylinder. These alterations, which, from being printed in italics in the report, constitute, I suppose, the improvements and inventions composing the new method, I will now examine seriatim:

1. By increasing the diameter of the pipes from ¾ to 2 inches, it is evident that, to obtain the same amount of radiating surface, the size of the condenser must be increased in the ratio of nearly 3 to 1, which, of itself, is no small evil in a steam vessel; but further, from the increased area of the pipes, they must be made of thicker metal, whereby their conducting power is diminished, and their cost augmented.

2. It is objected to Mr. Hall's arrangement of vertical pipes, that the condensed steam running down the inner surface of the tubes presents a non-conducting lining to them, and that its collection at bottom presents an obstacle to the current of steam, and causes a diminution of the effective radiating surface. I would reply that as the steam must come in contact with, and be condensed upon the whole surface of the pipes, the surface must be coated with a film of water whatever be the position of the pipes; and that if there is any difference in this respect, it would rather

be in favour of the vertical pipes, as the water might naturally be expected to fall from them more rapidly than from the horizontal pipes. But apart from this point, there is this objection to placing the pipes horizontally, that the water in the upper part of the condenser being hotter than in the lower part, the upper ranges of pipes become comparatively ineffective. This fact was noticed in the experiment, although it was not attributed to the right cause. As to the throttling of the steam by the immersion of the lower ends of the tubes in the condensed water; this objection would imply that the reporters have never personally examined Mr. Hall's apparatus, otherwise they would have known that the pipes are constantly open at top and bottom, and that the chamber beneath the lower ends of the pipes is at least equal in capacity to the air-pump, and is exhausted at each stroke of the latter.

3. With respect to the distilling apparatus—in the new method this is heated by a portion of the steam from the cylinder, which is admitted to it shortly before the close of the stroke by a valve worked by the engine. Independently of the additional space required by this arrangement and its complexity, there is this objection to it, that it requires that the steam should leave the cylinder at a high temperature, and of course at a corresponding pressure, so that instead of a vacuum of 28 ins., the highest obtained during the trial was only 205.

It is further objected to Mr. Hall's apparatus, that from the use of tallow or oil in the cylinder and on the valve-faces, the tubes become coated with oleaginous matter, which, acting as a non-conductor, materially obstructs the condensation of the steam; and it is stated that in the new method this is obviated by the high temperature of the feed-water, which is equivalent to "*imperfect condensation.*" Mr. Hall has provided an efficacious and less costly remedy for this evil whenever it actually occurs; but in any case he has only to employ a smaller extent of cooling surface; in other words, a cheaper but less efficient condenser to realise the advantages of the "new method."

From the report it appears that with a vacuum never exceeding 20·5 ins., in an experiment of twenty hours' duration, the saline matter in solution in the boiler is increased from $\frac{\cdot 68}{32}$. to $\frac{\cdot 75}{\cdot 32}$.

The above observations will, I think, suffice to show that the "new method" is in reality nothing but Mr. Hall's plan disguised by prejudicial alterations to make it pass for original.

I remain, Sir, yours, &c.,

London, May 9, 1848. W. X. Y.

ON THE DEVIATION OF FALLING BODIES TO THE SOUTH OF THE PERPENDICULAR. BY W. W. RUNDELL, ESQ., SECRETARY TO THE ROYAL CORNWALL POLYTECHNIC INSTITUTION.

The remarks of Professor Oersted at the Southampton Meeting of the British Association on the deflection to the south of falling bodies, and the variety of opinions entertained upon this subject by the most eminent men, not only in regard to its cause, but also as to its real existence, having attracted my attention, it occurred to me that the deep mines of Cornwall would afford facilities for repeating experiments on this subject which had never before been obtained to the same extent. The height from which the bodies fell in the experiments of Professor Guglielmani in 1793 was 231 feet (French) only, in those of Dr. Benzenburg, 240 feet, and in those of Professor Reich, which are accounted the best, the depth did not exceeded 540 feet, while the deep shafts of some of the Cornish mines would allow a fall of two and three times the amount of the greatest of these distances.*

* Extract from "A letter, on the deviation of falling bodies from the perpendicular, to Sir John Herschel, Bart., from Professor Oersted," printed in the Report of the British Association for the advancement of Science, for 1846:

"The first experiments of merit upon this subject were made in the last century, I think in 1793, by Professor Guglielmani. He found in a great church, an opportunity to make bodies fall from a height of 231 feet. As the earth rotates from west to east, each point in or upon her describes an arc proportional to its distance from the axis, and therefore the falling body has from the beginning of the fall a greater tendency toward east, than the point of the surface, which is perpendicularly below it; thus it must strike a point, lying somewhat easterly from the perpendicular. Still the difference is so small, that great heights are necessary for giving only a deviation of some tenth part of an inch. The experiments of Guglielmani gave indeed such a deviation; but at the same time they gave a deviation to the south, which was not in accordance with the mathematical calculations. De la Place objected to these experiments, that the author had not immediately verified his perpendicular, but only some months afterwards. In the beginning of this century, Dr. Benzenberg undertook new experiments at Hamburg, from a height of about two hundred and forty feet. The book in which he describes his experiments, contains in an appendix, researches, and illustrations on the subject,

By the courtesy of the Agents at the United Mines I was allowed to use their man-engine shaft in some experiments which were tried in the early part of this year. It is perpendicular and one quarter of a mile deep, and this great depth appeared to me, in this case, to be of some importance, as the deflection was likely to increase in a greater ratio than the errors arising from imperfection in the manner of dropping the bodies which are allowed to fall.

The value of experiments of this kind depending in a great measure on the goodness of the method employed for dropping the bullets or other heavy bodies that may be used, and not having the means of ascertaining that employed in the continental experiments, some trouble was taken to find one that should be as free as possible from objections, and after many preliminary trials the following was adopted:—A strong rectangular frame was constructed, having a shelf or stage inside it, capable of turning freely upon an axis, supported by pointed centres, fixed in the sides of the frame. This frame was placed in a horizontal position over the shaft; and when the moment arrived for dropping the bullet, its support was suddenly removed by turning the stage round its axis.

This plan, it is conceived, ensures the dropping of the bullet, without an appreciable tendency to any particular direction arising from the method employed. It may, perhaps, be objected that the cohesion between the shelf and the bullet would impart to the latter a motion in the direction in which the shelf moved. This is the case when the shelf is made to move very slowly, but when it is turned suddenly on its axis, even if it be some degrees from the truly horizontal position, no deviation arises from this source, as was clearly proved by preceding and subsequent experiments.

Besides the bullets, iron and steel plummets were used, the latter being magnetised. In form these were truncated cones, the lower and larger ends being rounded. These were suspended by short threads inside a cylinder, to prevent draughts of air affecting them, and when they appeared free from oscillation, the threads were let go. The number of bullets used was forty-eight and there were some of each of the following metals, iron, copper, lead, tin, zinc, antimony, and bismuth.

A plumb line was suspended at each end of the frame and east and west of each other; to these were attached heavy plummets, the lower ends pointed. After they had been hanging for some hours in the shaft, a line joining their points was taken as a datum line from which to measure the deflection.

The whole of the bullets and plummets dropped south of this datum line, and so much to the south that only four of the bullets fell upon the platform placed to receive them, the others, with the plummets, falling on the steps of the man-machine, on the south side of the shaft, in situations which precluded exact measurements of the distances being taken. The bullets which fell on the platform were from 10 to 20 ins. south of the plumb line.

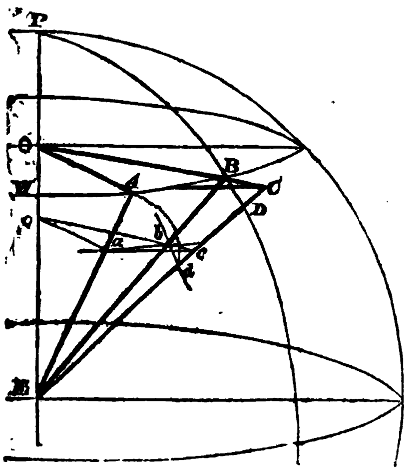
The deflection being much greater than I had anticipated could arise from any cause which appeared likely to produce a deviation, I feared the whole experiment was a failure, but more recent considerations have induced me to again test the method employed, I feel confident that the deflection is not due to errors arising from the method of dropping the bullets, and that it is not at all likely that draughts of air in the shaft had any important influence on the result, but that there is a real deflection to the *south of the plumb line*, and that in a fall of one quarter of a mile it is of no small amount.

I now beg to offer for the consideration of the society, the following, as an explanation of the cause of this phenomenon. Seeing that the subject has already been examined by many eminent men, who seem inclined to doubt the accuracy of the experiments rather than admit the fact of an observed southern deflection, and that some among those who are the best qualified to form an opinion on the subject, have stated that the deviation arising from the cause I propose would be inappreciable, this explan-

from Gauss and Olbers, to which several abstracts of older researches are added. The paper of Gauss is ill printed, and therefore difficult to read; but the result is that the experiments of Benzenberg should give a deviation of 3·95 French lines. The mean of his experiments gave 3·99; but they gave a still greater deviation to the south. Though the experiments here quoted seem to be satisfactory in point of the eastern deviation, I cannot consider them to be so in truth; for it is but right to state, that these experiments have considerable discrepancies among themselves, and that their mean therefore cannot be of great value. In some other experiments made afterwards in a deep pit, Dr. Benzenberg obtained only the eastern deviation; but they seem not to deserve more confidence. Greater faith is to be placed in the experiments of Professor Reich, in a pit of 540 feet at Freiberg. Here the easterly deviation was also found in good agreement with the calculated result; but a considerable southern deviation was observed. I am not sure that I remember the numbers obtained; but I must state that they were means of experiments, which differed much among themselves, though not in the same degree as those of Dr. Benzenberg. Professor Reich has published his researches, an abstract of which is to be found in Poggendorff's 'Annalen der Physik.' After all this there can be no doubt that our knowledge on this subject is imperfect, and that new experiments are to be desired."

ation is submitted with great diffidence, fearing that possibly some essential part of the subject has been overlooked.

If falling bodies be acted upon only by the gravitating and tangential forces, the plane in which any falling body moves will be indicated by two lines, one line joining the point from which the body falls and the centre of gravity, and the other a line at right angles to this line forming a tangent to that part of the circle of latitude, which is situated in the falling body at the *instant it begins to move*. Taking the earth as a perfect sphere, and the centre of gravity coinciding with the geometrical centre, this plane will cut the earth in a great circle, and is of course stationary, that is, it does not rotate with the earth. Now, while a falling body is moving forward and downward in this plane, the point from which it fell is moving round in the circle of latitude; and the line joining that point and the centre of gravity lies no longer in this plane, but has described part of the surface of a cone round the axis of the earth; consequently the falling body must be some distance outside this cone and to the south of the vertical line passing through the point from which it fell.



Let A in the above figure represent a point in the circle of latitude, WAB, from which a body is about to fall; PE, part of the axis of rotation of the earth, and E its centre: let B be the position of the point A, after the lapse of 9″ the time which, theoretically, a body takes to fall a quarter of a mile. Through B, draw the line OC, in the plane of the circle of latitude, make AC a tangent to this circle at A, and join OA, AE, BE, and CE; then ABE will be part of the surface of the cone spoken of, and ACE will be part of the plane, lying outside the cone, in which the falling body will move. Let PD be a meridian passing through B, and *bd* parallel to BD, and a quarter of a mile deep, make *bc* parallel to BC, and let the dotted line, A*d*, represent the path of the falling body; then *bd* in the example here given will not differ to any appreciable extent from the deflection to the south, of a body falling from A in the time measured by the angle AOB.

A quarter of a mile being a small distance compared with the earth's radius, and the angle BEC being exceedingly minute, *bd* may be considered equal to BD, and BD is equal to BC multiplied by sine of latitude of B, for the angle BCD equals latitude, and CBD is a right angle. In this example, the angle AOB is equal to 9″ of time, and BC the excess of secant over radius of this angle, in latitude 50 is equal to 2·877 feet, which multiplied into nat. sine of latitude equals 2·2 feet, the deflection *from the prime vertical* of a body falling a quarter of a mile in 9″ in latitude 50.

As, however, the deflection to be accounted for is one south of the *plumb line* in north latitude, it is necessary to inquire how much the plumb line itself is deflected from the vertical by the tangential force. Now taking the ratio of the centrifugal force at the equator to be that of gravity at that place as 1 to 295, which is about a mean between the values given by the English and French astronomers, we have

$$\frac{180^\circ \times 60 \times 1}{3\cdot14159 \times 295} \cos l \sin l =$$

the angle of deflection, which will give for the deviation of a plummet hanging by a line a quarter of a mile long in 50° north lat. a distance of 2·2 feet, or exactly the same amount as the deflection to the south of a body falling the same distance in 9″. But, as 9″ is the theoretical time, or the time a body would take to fall a quarter of a mile in *vacuo*, and as the air offers considerable resistance to bodies moving with great velocities, it follows that a body falling through a quarter of a mile in air, will take longer than 9″, the angle AOB will be increased to the same extent, and the falling body will therefore be to the south of the plumb line. I am not acquainted with any satisfactory data for calculating the retardation that would be due to the resistance of the air, but assuming the whole time the body is falling to be 10″, the deflection to the south of the plumb line will be ·5 feet, if 11″, 1·09 feet, and if 3″, 1·6 feet.

Besides the deflection of the plumb line from the line passing through its point of

suspension and the centre of gravity, arising from the rotation of the earth on its axis, it is further deflected south when considered as normal to the terrestrial *spheroid*. This deviation is caused by the attraction of the equatorial protuberance; and as the angle of the vertical is equal to

$$\frac{180^\circ \times 60 \times 1}{3\cdot14159 \times 295} \sin 2l,$$

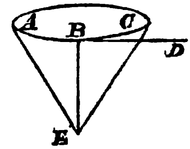
or double the angle of deviation due to the earth's rotation, it follows that these deviations are equal to each other. Falling bodies will also be deflected south by the same cause, but it will be seen on examination, that the deflection arising from this cause will bear no relation to the time of the fall, but be directly proportional to its distance, consequently, no deviation to the south of the plumb line will be occasioned by it. It seems probable, therefore, that in experiments on falling bodies in lat. 50° N. with a fall of a quarter of a mile, the deviation to the south of the quiescent plumb line will be that which has been given above, as the amount that would be due, under the given circumstances, to the tangential force acting through a longer time than the theoretical one, the increased time being occasioned by the resistance offered by the air.

I hope to have the pleasure of laying before the Society, at the next annual exhibition, an account of further experiments on this subject, which will include the times bodies take falling through given distances, with the deflection south at the same depths. In these experiments I hope to be able to avail myself of some very valuable suggestions, which have been kindly made to me by Sir John Herschel and Mr. R. W. Fox.

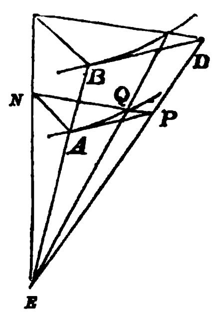
The Rev. Professor Cowie, M.A., Principal of the Engineering College, Putney, has kindly permitted me to insert the following extract from a letter I have recently received from him, in which the question of the southern deflection of falling bodies is very clearly stated. I have much pleasure in being allowed to do this, as the quotation will be found to support the view of the subject which has been taken in the preceding paper. W. W. R.

"——— The question of the stone dropping is a dynamical one, which cannot be solved with nicety, on account of our very imperfect knowledge of the laws of fluid resistance; but I think we might conclude that the following method, which avoids all discussion of the laws of aerial resistance, might help us to arrive at something like a practical mode of computing the southern deviation of the stone: for that there is a southern deviation I have no doubt."

"Let ABC be the parallel of latitude in



which the stone is dropped; E, the centre of the earth, or the point where the vertical at B meets the earth's axis. BE is the direction of the plumb line at B. The stone is acted upon by two forces, the tangential in direction BD, the attraction in direction BE; the plane through these two directions is the tangent plane of the cone DBE; this plane touches the cone only along the line BE, and, therefore, if there is eastern deviation, there *must* also be southern deviation; the eastern will be much the greater, and therefore the best way is to express the southern deviation in terms of the eastern: the same errors will equally affect both, and *may* possibly be eliminated. To ascertain whether this really is so, would require considerable discussion of the actual modes of experimenting and measuring."



"Borrowing your figure, and exaggerating as much as possible the effects in the drawing, in order to see clearly what takes place, let EBD be the tangent plane, BP the path of the falling body, so that P is its place at the end of the experiment, A the bob of the plumb line. AP is the whole deviation. AQ the eastern deviation,* and QP the deviation in a plane perpendicular to the earth's axis—

So that $AQ = e$ the eastern deviation.

$s = QP \sin l =$ the southern deviation.

$e =$ arc AQ or chord $AQ = (a \cos l)$ angle ANQ (NE being the earth's axis.)

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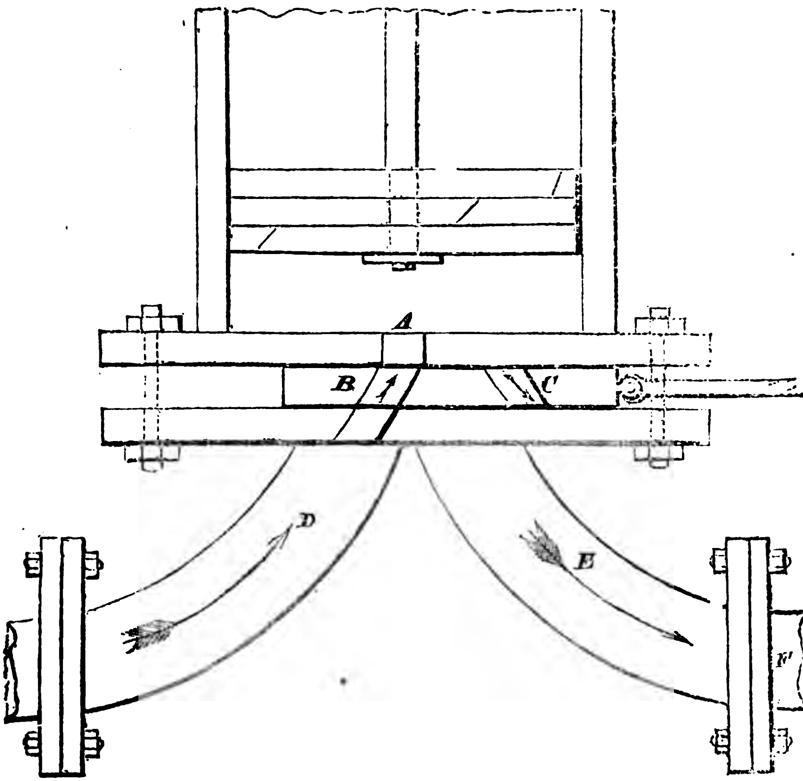
* To prevent any error which may arise from giving a false value to the angle ANQ, the following quotation from a subsequent note from Professor Cowie is made,—"Of course the eastern deflection from the plumb line is (the quantity (e) minus the space described in the same time by the plumb line.")

$$PQ = PN - NQ = AN \sec ANQ$$

$$s = a \cos l \sin l \left\{ \sec\left(\frac{e}{a \cos l}\right) - 1 \right\}$$

which gives us the southern deviation corresponding to an eastern deviation (e)—this latter is susceptible of measurement, and it may then be calculated whether (s) is sensible or not."—*Trans. Roy. Cornwall Polytechnic Institution.*

HYDROSTATIC-PRESSURE ENGINE.



Sir,—The above sketch explains the principle of an engine which I have contrived, for employing hydrostatic pressure as a motive power.

B C is a side valve with diagonal ports. When it is placed in the position represented in the sketch, a column of water descending from a reservoir is admitted through D and A, to the cylinder, and *raises* the piston.

When the position of the valve is reversed, so that C is opposite A, a passage to the exhausting-pipe E, is opened, of which the continuation F is prolonged downwards, to such a depth (not exceeding 33 feet,) as may be attainable, so that the whole weight of the lower column of descending water, as it leaves the cylinder which is open at the top, acts through the medium of atmospheric pressure, in *drawing down* the piston.

I am informed, that in some of our large towns, the use of water at considerable pressures is procurable for mechanical purposes: and it may be probable, in cases where an engine of *small* power only is required, that it may be applied as a motive power—safe, convenient, and economical; especially when the situation of a workshop admits of the full effect of the descending-pipe F.

It is obviously desirable that some sort

of air vessel should be connected either with the cylinder, or the adjoining induction pipe to give an elasticity to the stroke of the upper column of water; which, without such an addition, would probably act injuriously on the parts in connection with the piston.

I remain, Sir, your obedient servant,

J. H.

Stone Easton, Bath, April 28, 1848.

ON THE VINEGARS OF COMMERCE AND THEIR ANALYSIS. BY ANDREW URE, M.D., F.R.S., ETC.

[From the *Pharmaceutical Journal* for May, 1848.]

There is probably no article of extensive consumption in this country so subject to variation in its strength and purity as vinegar. The sour liquor manufactured from malt contains generally so much gluten as to be very prone to putrefy, were not this offensive change counteracted by the addition of oil of vitriol—an adulteration sanctioned by law. This is a miserable shift, or pretended necessity, in the present advanced state of organic chemistry. It offers besides an easy source of fraud, since neither the retailers nor consumers of the article are competent to distinguish how much of the sourness is derived from the mild fermented, and how much from the corrosive mineral acid. All the pickles in which our *bourgeoisie* so much delight, are polluted by the same sophistication. Not long since, a sample of vinegar was submitted to me for examination, said to be that supplied by contract to the British navy. I found it to contain little more than half the fair amount of *proof* vinegar, with much gluten, and a copious supplement of oil of vitriol. Our Admiralty might buy such stuff at a low price; but it was dear at nothing, since it would derange all ordinary stomachs.

The strength of vinegar, as of acids in general, may be determined by the proportion of alkali which a given weight of it will saturate. For this purpose I give the preference to water of pure ammonia, of specific gravity 0·992, because 1000 water-grain measures of it neutralize 60 grains of real acetic acid hydrate, which contains 1 atom of water = 9, and 1 atom dry acid = 51. Our excise proof vinegar contains 5 per cent. of this latter acid, and therefore nearly 6 of the hydrated acid. Hence, 1000 water-grain measures of proof vinegar will neutralize 1000 water-grain measures of the test-water of ammonia. If 1000 water-grain measures of another vinegar neutralize only 600 grain measures, that vinegar is 40 per cent. under proof. But a further deduction must be made on account of the mineral acidity by the following method:—

Evaporate 1000 water-grain measures of the vinegar, in a porcelain or glass basin, by the heat of a brine-bath (225° Fahr.); weigh the residuum, then wash it with alcohol of 0·840, and filter. The sulphuric acid will pass through in the spirit, and may be estimated either by the test ammonia, by evaporating the spirit and weighing what remains, or by precipitation with any soluble barytic salt, and determining the amount of sulphate of barytes. The gluten may be ascertained by ignition of the filter, previously weighed dry; the saline or alkaline impurities will remain for examination. The fixed alkali will be probably soda, from acetate of soda, occasionally present in wood vinegar, which is sometimes used to strengthen decayed or ill-fermented malt vinegar.

The treatment of the residuum with alcohol above prescribed, is essential to distinguish between sulphuric acid and sulphate of lime, which latter substance is unavoidably present in the vinegars of such factories as are supplied with gypseous well waters. Sulphate of lime is insoluble in spirits of the above strength.

Weak vinegars have been occasionally fortified with nitric or muriatic acid. The former is detected by letting fall a drop or two of sulphate of indigo into the vinegar, and applying heat; when the blue tint will change to yellow-brown. To detect muriatic acid, distil a portion of the vinegar, and introduce into the receiver a few drops of nitrate of silver. A white curdy precipitate will betray the muriatic acid.

The tendency to putrefaction in malt vinegars, may be obviated by oxidizing the gluten, and thus rendering it insoluble. It is to this plan of discharging the gluten in the Bavarian beer process, that the limpidity and keeping quality of this wholsome beverage are justly ascribed by Liebig, and other great German chemists. A like oxidizement of malt vinegar is accomplished in the modern improvements of Ham's patent method of acetification, as described in my paper on Acetic Acid in the December number of this journal (vol. vii., p. 286). I have recently had an opportunity of verifying the truth of this proposition, in the minute analysis of malt vinegars made in that way on the great scale, at the works of Messrs. Hill, Evans, and Williams, of Worcester, which vinegars are well-flavoured, and keep well, without one drop of sulphuric acid. A malt liquor thus perfectly acetified, must be far more wholesome than our ordinary half-fermented vitriol-holding vinegars, and preferable even to much of the pretended wine-vinegar of France, fortified too often by the more or less acrimonious acid distilled from wood.

24, Bloomsbury-square, April 18, 1848.

MR. J. D. HAILES'S UNIVERSAL ORRERY GLOBE.

[Registered under the Act for the Protection of Articles of Utility.]

The readers of newspapers must have noticed frequently in the course of the last two or three years sundry curious advertisements signed "John Davey Hailes," offering to solve problems in science which have hitherto baffled the skill of the most profound men of all ages.* The earliest in date is in these terms:

"UNIVERSAL
SCIENTIFIC CHALLENGE.

TO ALL PHILOSOPHERS, ASTRONOMERS, GEOGRAPHERS, AND MATHEMATICIANS, IN THE WORLD.

"*July* 17*th*, 1845, A.D.

"The PHILOSOPHERS—I challenge to substantiate the true principle of the Magnet, which shall prove what the variations at London have been at each one hundred years in the past five thousand, and what will be the variation *each hundred* for the next coming thousand years.

"N.B.—The above I can accomplish.

"The ASTRONOMERS—I challenge to establish *by the Solar System the Moon's acceleration of Time*, which principle the Solar Sages admit, although unable to discover the causes.

"N.B.—This *Time I can establish in My System.*

"The GEOGRAPHERS—I challenge to prove that *Gibeon* at this period, 1845, is *not* 32·30 north latitude; I believe it near 33 *north latitude.* If not, the Valley of Ajalon is less than half a degree north of Gibeon.

"N.B.—My object is to prove Joshua's (SUN and MOON) Miracle by *Time, Latitude*, and *Magnetic principle.*

"The MATHEMATICIANS—I challenge to calculate the true period of Ancient Eclipse of Moon, recorded—Circa tempus occisi Cæsaris—Pliny-Meminit, 1. 2. c. 30, Jul. Obseq. Virg. 1 Georg.

"N.B.—Which I say happened about midnight at Rome. Now discover the *Month* and *Year Time.*

"JOHN DAVEY HAILES,

"*Linton, Cambridgeshire, England.*

"P.S.—I find mathematically the *Variations of the Magnet at Gibeon*—the period, 1847—is near 15 degrees west of the Meridian."

A later—though not the latest—was as follows:

"A CHALLENGE TO ALL THE WORLD."

"To produce a System of the Sciences, upon a principle that shall Measure the Time when the Sun was Vertical to Gibeon, as recorded by Joshua, and afterwards to Syene, as recorded by Strabo, Pliny, &c.

"In a Letter, dated November 21st, 1846, I made an offer to the Three Royal Societies of London, that I would produce such a system, and after I had established the principle, to receive the reward which might be agreed upon. Having to this date received no reply, I suppose they are either ashamed or afraid to meet me. I now make the same offer to the World, the Meeting to take place at London, and the Question to be decided by a majority of any number of persons—chosen from the most learned in the Societies throughout Europe—and if I fail in establishing the principle, I forfeit ONE THOUSAND POUNDS.

"JOHN DAVEY HAILES,

"Linton, Cambridgeshire.

"*At Wigford House, Kingsbridge, Devon.*
Feb. 16*th*, 1847."

The "Philosophers," the "Astronomers," the "Geographers," the "Mathematicians"—the "three Royal Societies of London," and "the world" at large, having all equally shrunk from accepting these brave challenges, and ample time having been allowed to all and sundry to carry off, *if they could*, the golden prize ("one thousand pounds!"—enough to tempt the proudest from their perches)—Mr. Hailes has reasonably enough come to the conclusion, that it is of no use waiting any longer, and that it is now high time he should speak out. By way of a first step in this sensible direction, he has registered this week an astronomical apparatus, by which he offers to demonstrate to the eye the truth of everything he asserts. The accompanying engravings have been made from the originals in the office; and the following is the description annexed:

Description.

"Fig. 1 is an external elevation of this apparatus; and fig. 2 a plan of the same. It consists of two globes, H and E, one (H) representing the heavens and the other (E)

* Published in a collected shape, by Kettle, 256, High Holborn.

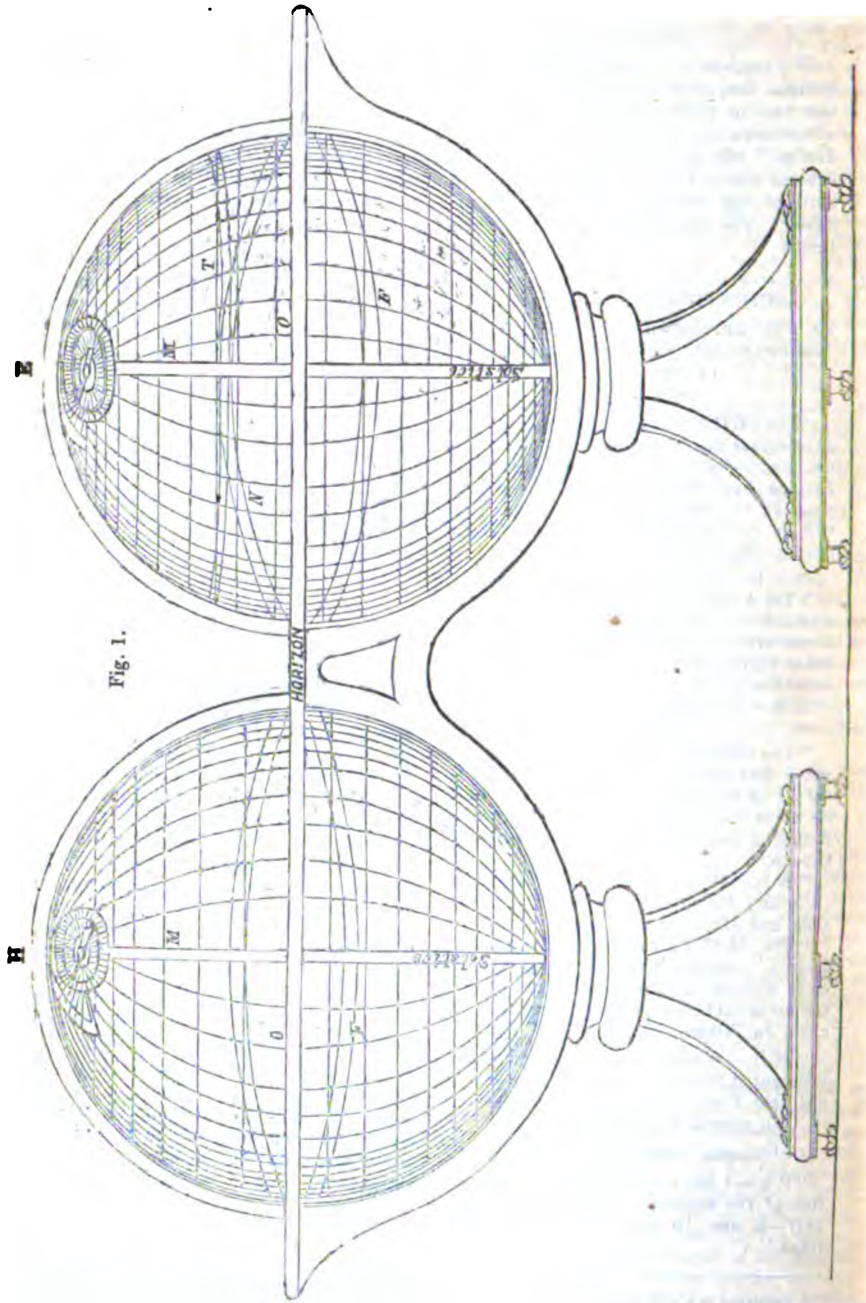


Fig. 1.

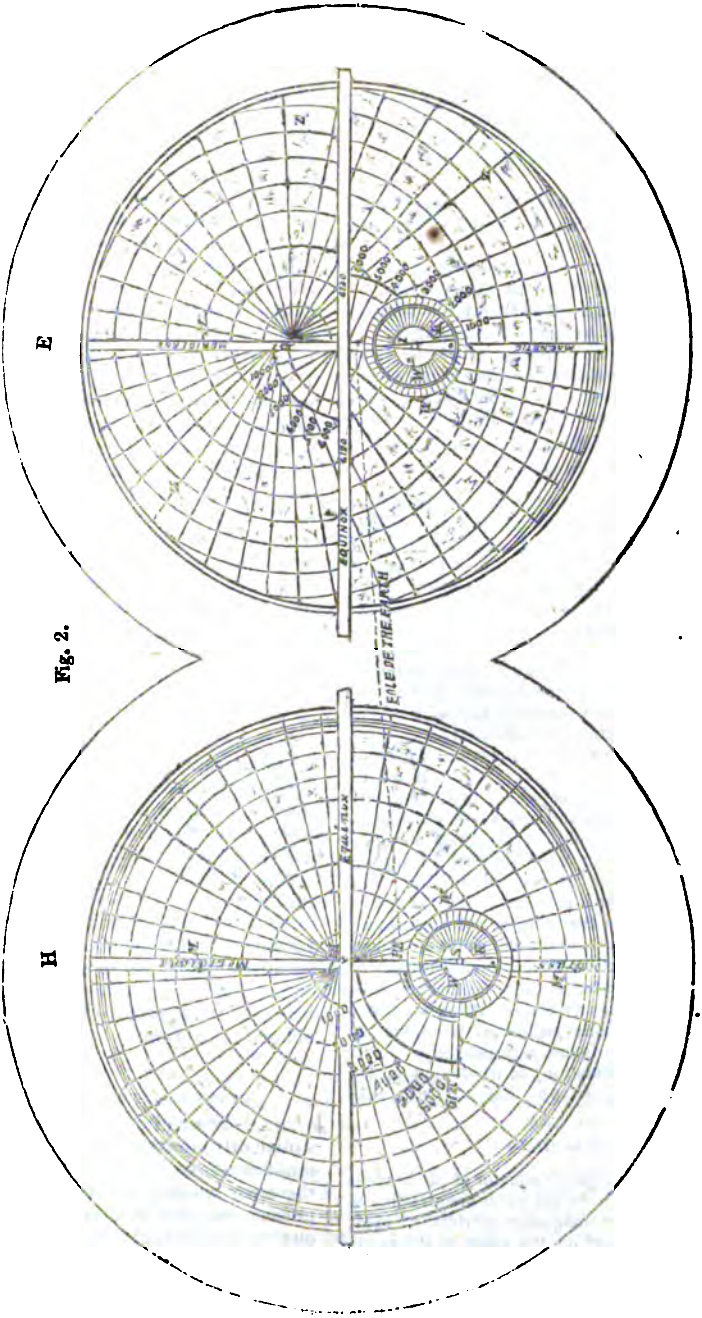


Fig. 2.

the earth, which are provided with certain appendages, whereby the following, among other astronomical facts, may be demonstrated.

"*First.* The movement of the sun over Gibeon, as recorded by Joshua, and after a time at Syene, as recorded by Pliny, &c.

"*Second.* The retrocession of the equinoxes.

"*Third.* The sign of the ecliptic, in which every eclipse has happened and will happen to the end of time.

"*Fourth.* True mean time, for all time.

"*Fifth.* The change of the meridian.

"*Sixth.* Increase and decrease of latitude, with change of variation of the magnet.

"*Seventh.* That the poles of the earth move exactly between the poles of the world, and the centre or pole of the sun; that is, on globe H, for on globe E the poles of earth are magnetic points.

"*The Globe H.*

"PE represents the position of the pole of the earth at the creation, and PH the relative position of the pole of the heavens at the same time; S, the centre of the sun or ecliptic; FF, represents a quarter of the globe, for the purpose of showing the movement of poles which causes the retrocession of the equinoxes. MM, two brass meridians which are moveable upon the pole of the sun. N is the equator of the heavens, and O the equator of the earth; both of which equators are affixed to the brass meridians, and serve to show two moveable equinoxes and solstices. W^1, is a wheel, the circumference of which is divided into 34 equal spaces, and moves in correspondence with the poles of the earth and heavens. W^2, is an inner wheel of 10 degrees diameter, which is centred on the same axis as W^1, and is divided into 18 equal spaces. From the space *one* of each wheel, there projects towards the poles an index-hand, *i i*. K, is a moveable indicator which is fixed on the top of the axis of the wheels, W^1W^2, and has a ribbon or string appended to it, by which the latitude of the moon can be at any time found, and also (with the aid of a little calculation) in what sign of the ecliptic every eclipse has and will take place.

"*The Globe E.*

"On this globe the equator of the heavens and the ecliptic to the earth are attached to the two brass magnetic meridians, MM, which are moved on the poles of the earth, and give the equinoxes and solstices, to which should be fixed moveable wire meridians, Z, from the poles, Q, corresponding with the heavens, on a different principle to the globe H, showing the increase and decrease of latitude to different parts of the earth at different times. At the two brass magnetic meridians there is no variation of the magnet; and from brass to brass meridian, on one side of globe, there is a west variation, according to latitude of place; and from brass to brass meridian on the other side of the globe there is an east variation, according to latitude of place; and the movement of magnetic meridians over the figure B causes change of variation. T is a moveable summer solstice around the globe E."

We cannot pretend to say that we quite comprehend all this; and we infer from an announcement by Mr. Hailes that the registration of his "Orrery" is intended to be followed by a separate treatise explanatory of its uses, that he does not expect of any one, that he should be able to make himself master of it, from the description alone. A person uninitiated in the mysteries of registration may ask, why Mr. Hailes did not make the description so plain as that every one might at once understand it? The Registration Act furnishes the answer. But a certain space superficial (24 ins. by 15 ins.) is allowed for both the drawings and description of every invention—be it great or small—simple or complex. You are expected to be able to describe an apparatus illustrative of the movements of the universe, in the same number of words as the commonest clock movement—to take up no more space with the description of an entire machine, than with the description of any pin or bolt in it! It is but a natural consequence of this absurd regulation that the office descriptions of registered inventions must be often imperfect and unsatisfactory. Mr. Hailes' case is but one of many—the fault not his, but theirs who made the law to which he has been obliged to conform.

SYLVA SYLVARUM NOVA.

Sir,—Those of your readers who were sufficiently interested in my former communication under this title to induce them to accompany me through the present one, will be prepared to resume our train of thought by the mention of two great causes of the vicious state of things I have been endeavouring to depict.

A certain accidental condition, or a

predisposing influence, appears to be the first; and it may be described as the *general ignorance* which, whether wilful or not, of course includes that particular ignorance by which a man knows not how best to employ his hands or brains, either to reap fruit for himself or to rear it up for others. Upon this head I have nothing to observe, and I mention it merely to acknowledge its existence, and to remark, that all our exertions for the promotion of general knowledge will tend to remove it. But while every reception of sound education will be attended by an increase in the prudence of those who desire to lay out their capital of manual skill or mental ingenuity, and will, therefore, deserve encouragement (if only for these reasons) at our hands; yet it is the second cause of the disease which I intend to dilate upon, and I do so because I think it acts as an immediate one, and that it may, and ought to be removed. It is also *a want*, but not included even under the comprehensive head of education.

It is not so much a general as a particular want—one which appears to me not to demand ages for the growth of its supply, and the patriotism of philosophy should be ashamed any longer to suffer its existence.

I conceive, Sir, that we are in need of trusty guides in knowledge—of thoroughly ascertained land-marks of information—of a distinct line of separation in every department of philosophy between what is already known, discovered, and attained to, allowed to be true by all—capable of verification every day, as fruit *gathered* from the tree of knowledge; and, on the other hand, what is conjectured, or suggestive, or probable, or possible—fruit, but not ripe, and whose nature, when mature, we cannot predict.

We must have more definite charts of the precise boundaries in each direction of the territory already enclosed by human learning. It may be tempting to the sanguine enthusiast to mark, as ascertained, whole continents seen by one traveller alone, where none can follow to support or contradict him, and thus gradually to shade off our map into the centre of unexplored regions; but, surely, the more sober explorer will prefer to see a clear mark drawn round those points, which all can verify, those towns, and rivers, and mountains, the position of which each for himself can corroborate by a visit to-morrow. Or, again, we require still (to recur to the metaphor I have employed before) to have distinctly shown to us who are our enemies, which of them are already subdued, what is their next assailable point, how it is recommended (by able tacticians) to attack it, and, finally, *what will the booty be*, should the victory be for us. Those fiery volunteers whom we have seen ambitious of a battle for the demolition of ignorance, and ready to skirmish with any phantom which may arise, will then have it on their own heads, if they do not fight with unconquered foes at the best time, in the best mode, and for the most substantial prize. This line of demarcation between the ascertained and the debateable, distinguishing facts and principles incontestably established, from those only gaining ground, and which, though surely, yet are merely yielding to investigation, would benefit not only those who delight to study what is known as "truth," but those also whose energy urges them to add to the stock which is already the property of mankind. From the tenor of the above remarks, it may be gathered that the advantage of this latter portion, and its more complete fulfilment, is the subject of my present consideration, and I may, therefore, enunciate the matter in hand in the following proposition:

"That the ingenuity and genius, as well as much of the manual skill now misdirected in attempts to invent impossibilities, or to rediscover what has long been well known, might be usefully employed, were those who employ such faculties to be furnished with accurate descriptions of what is already ascertained, what is yet to be discovered, what efforts have been made for such advance, and in what direction it is considered by competent judges, inventive talent would seem to command success, together with the probable value of the success when attained."

To illustrate this more in detail, I shall select an individual practical case; for instance, the nascent science of electricity, and here we should find laid down—

I. The known, including,

1. Results of experiments (without the theories to be built upon them,) *e.g.*,

friction between glass and silk produces electricity.

2. Orders and arrangements of the various bodies in nature, tabulated in respect of their electrical properties; *e.g.*, classification of electrics, conductors, &c., together with accessory analyses and formulæ.

3. Well ascertained facts supposed to be connected with electrical action between bodies, but, however produced, at least, immediately reappearing under the same visible conjunction of circumstances; *e. g.*, the repulsion of contiguous particles of fluid.

4. Authenticated results, requiring costly apparatus or lengthened process for their exhibition; *e. g.*, Faraday's late researches connected with polarized light.

With all these may be intermixed hypotheses *ad libitum*, but clearly indicated as distinct.

II. A sketch of the efforts at discovery, and the important failures made in each department of the science by the various eminent electricians, detailing only such of their notions and observations as have not yet become *undeniably established*.

III. Plain suggestions as to the most advisable points for further immediate investigation.

1. For the purpose of establishing or extending theory; *e. g.*, specified experiments on the connection between magnetic and common electricity.

2. For the attainment of practical ends in manufactures, commerce, or convenience and civilization; *e. g.*, particular desiderata in electric telegraphs, defects in magnets, improvements in batteries, the application of electricity to agriculture, &c.

If it be objected that Section I. would monopolize a whole volume, I shall hazard the assertion that if this plan of division be carried out (for the sake of trial) by marking the paragraphs in our present standard text books, it will be found that not only in electricity, but in almost every other science, except geography and history, the amount of what can be unhesitatingly set down as "known" is but a small portion of what occupies the bulk of treatises on the subject.

Section II. would be of immense service in the prevention of numerous *second discoveries*. As in the patent register, so in this many a wiseacre might read, formally announced, some fifty years ago, the darling project which he was about to commit himself to for life. Here, too, might be emblazoned in suitable characters the precise amount of the several "Government rewards" for perpetual motion, philosophers' stones, and the elixir vitæ!

But both these sections, as I suppose, are subordinate in importance to the third head. I can imagine it as a distinct work in which each art and science would have a place—a sort of "Handbook for the Empirist and Inventor." But it is needless to remind your readers that I cannot hope to master such a project. I shall be content if I grapple with it long enough to attract the attention of those who are more competent to deal with a work so engaging. The depth of a mind, the largest that ever thought philosophy, has been already filled with the idea I am inviting them to consider, for *this* was the favourite scheme of Bacon, and, doubtless, had it been matured by him, it would now stand a monument worthy of its author. His conception of the plan, however, was too grand for even *his* ability to accomplish.

The groundwork of the mighty *fabric* was laid out with ample magnificence, but the architect could hardly complete a corner of the vestibule. Still we may judge from this specimen what might yet be the splendour of the edifice when finished, and I am not without hopes that this work may be recommenced. It is *not* beyond the abilities of man, were but the principle of the division of labour skilfully applied in attempting it, for the study of Bacon's works has been prosecuted with more and more ardour during the last twenty years. Men of science would now blush to be considered ignorant of his writings, and many tyros in philosophy are familiar with the "Ten Centuries," that earnest of a legacy yet unpaid, which under its second title of "Sylva Sylvarum," it has been my endeavour to point to, in these remarks.

The sagacious chancellor marched so far in advance of his age, that we are only now overtaking his footsteps—increased admiration of his system ever accompanying a more intimate acquaintance with his works; and we may anticipate that at least ample justice will be done to this enlarged demand for his writings by that eminent commentator

who is now engaged in preparing the supply.*

And now, Sir, this long preamble may require apology. But when once I have introduced Bacon, I claim attention to him from your readers *as a right*. Let us do more than admire the great advocate of the Instantia Crucis! Surely his noble conceptions are as worthy to be developed in our age as in his! We observe the profoundest philosopher of the world, after the most mature consideration of the subject, deliberately propound a system which he affirms to be the most suitable in his estimation for the advancement of learning. There *must* be weight in what comes from Bacon. If applicable to our times, Bacon's advice *must* be amongst the best; and who is there, who will not allow that the more science extends its boundaries, so much the more need is there, for union amongst its votaries, and economy and centralization of their efforts?

Let us, then, take the "Ten Centuries" for a model. We need not fear to copy what has come from the studio of such a master. Let us have on record the prophetic speculations of the Gausses, and Faradays, and Humboldts, as the pioneers of our journey, and then, mayhap, we shall make use of their talents as leaders, and not merely attempt to come up with them by travelling at our slow pace through all the difficulties they have encountered.

How *can* men be aware of what is doing by those of congenial philosophic bias with themselves, when such information is dispersed through innumerable books, and pamphlets, and serials, crowded with other (useful) matter? Thousands are eager to engage in patient research, and to prosecute discovery; but, like Columbus, they have no guide but their own sagacity to indicate where the new land is likely to be found, and they would hail with joy the appearance of a monitor which might condense the suggestions of the more keen witted, and tell them where their exertions might be expected to be rewarded with a prize.

I long to see the pages of such a work, and with your permission, I shall give the outline which is now present to my conception of it. I am, Sir, &c.,

JOHN MACGREGOR.

* Mr. Ellice, of Trinity College, Cambridge, now engaged upon a new edition of the works of Lord Bacon.

TURKISH HOOKAH VENTILATOR.

Sir,—In a recent clever contribution to your excellent Journal, by my ingenious friend, Mr. Dredge, he illustrates his meaning by referring to the Turkish pipe. I had a model constructed, and while looking at it in action, it occurred to me that the principle was susceptible of application to purposes of ventilation. Let us suppose a reservoir of water, sufficiently often renewed: in winter it might be warm, in summer cold. A simple air-pump—the few tubes necessary, of sufficient diameter—having been properly arranged, might be set in motion, yielding an ample supply of moist, fresh air, devoid of all impurity. Moist air is beneficial in certain diseases. I would recommend a ventilating apparatus, on the principle here laid down, to the consideration of the managers and directors of the Hospital for Consumption. For the treatment of consumption in private houses it would likewise be applicable, also to that of pulmonary inflammation. There would be no difficulty in fixing the apparatus. It might be worked by hand, by a smoke-jack, by the wind, or even by a turnspit-dog. The water, if desired, could be impregnated with perfumes or with medicinal substances, the genial, and, it might be, healing influence of which would flow in with the air current.

The foregoing suggestion is calculated to find favour in warm climates—Egypt, the Indies, Australia, Africa, and even the south of Europe. There, would be coolness and pure moist air, free from dust and insects. Any one who has sat ill at ease—perhaps sick—consumed by a glow that seems to inflame his very blood, could appreciate the relief accruing from a pure, moist, temperate atmosphere, free from winged plagues, sand, dust, and every impurity. Air, were it from impurest sources, could hardly escape the deterging influence of a chlorine or vinegar wash. The apparatus I recommend would answer better than the punkah, which merely drives the same foul atmosphere backwards and forwards; or the reed screens, drenched with moisture—lattices, by means of which suffering Europeans try to mitigate the sultry torment.

I am, Sir, yours, &c.,

H. M'CORMAC, M.D.

Belfast. May 13, 1849.

AIR-TIGHT CASES AND JARS.

Fig. 1.

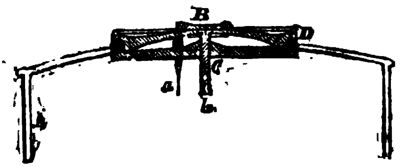
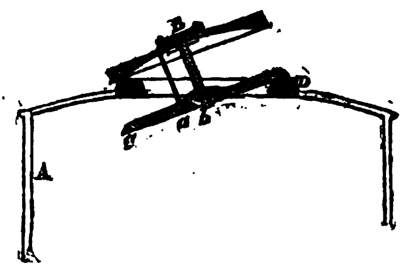


Fig. 2.



Sir,—Having some time ago occasion for an air-tight case, or jar, I designed the one of which I now forward you a description. The value of air-tight cases for shipping certain articles is well known. My object was not to obtain a permanently hermetically sealed case, but a useful article capable of various applications, having a pretty large aperture when open, and therefore, very suitable as a package for keeping biscuits, or anything perishable, from the attacks of insects or the influence of the atmosphere, or even of water, if submerged.

The above figures represent tin canisters, the first closed, the second in the act of being opened.

The references to both are alike; A is the tin canister; B, a cast metal circular lid, having a screw *b*, in the centre, passing through a metal bar C, and marked by a thumb-screw on the outside; the whole is inserted in a cast metal rim D, soldered to the canister. Fig. 2, may represent the removing, or inserting of the lid B, into the metal rim D. Supposing it replaced; then to fasten it, we have only to turn the thumb-screw at B, when the bar, C D, will turn round until it strikes the check-pin *a*, which will arrest its further progress; it will then arrest the screw until it acquires the position seen in fig. 1. Under the thumb-screw, is a small metal button and washer of vulcanized India rubber, which effectually seals any aperture at the screw.

The vessels to which this contrivance is applied may be of metal, earthenware, or glass; it is only requisite to have the lids accurately turned, if of metal—or well ground, if of any other material; but in all cases, the bar C, must be made of metal. A metalic case, even with an aperture of 6 or more inches diameter, when thus secured, is both air and water-tight.

I am, your obedient servant,

HENRY D——.

London, May, 1848.

ON THE PRESERVATION OF WOOD INTENDED TO BE EMPLOYED FOR BUILDING PURPOSES, AND MORE PARTICULARLY FOR RAILWAY SLEEPERS. BY MESSRS. B. HUTIN AND BOUTIGNY.

[Translated from the *Moniteur Industriel* for the *Mechanics' Magazine*.]

It is the constant action of the moisture and the oxygen of the atmospheric air, which, penetrating into the very heart of the wood by absorption and infiltration, produce on the elementary fibres a slow combustion, which destroys the wood, and to which Liebig has given the name of *eremacausis*. These elements of destruction enter by the ends of the wood only, and according to the grain; hence it results that, if they are not allowed to operate upon the wood, it may be preserved for an almost indefinite period. Observation and experience, as well as scientific data, indicate that the most natural way of effecting this, is by hermetically closing the absorbing extremities of the wood. The methods which have been employed, or proposed to be employed for this object, have been deemed inefficient by the authors, and they have therefore suggested a new one, which is as follows:—They propose to dry the ends of the wood, to neutralize their hygrometric properties by a slight combustion, and to hermetically close them by means of a mastic, which penetrates between the fibres, incorporates itself with them, and prevents their being deteriorated by the destructive elements referred to. This process, which is stated to be simple, cheap, capable of being carried out by any

workman anywhere, and not to require either machinery or workshops, is performed in the following manner:

1. The ends of the wood are immersed in a carburet of hydrogen, such as Schist oil, which penetrates very far and very rapidly into the wood.

2. The ends are fired, and the moment the flame goes out, are then plunged, to the height of a few inches, in a hot mixture of pitch, tar, and gum-lac, which is slightly sucked up between the fibres, so as to form at each end a sort of hermetic seal.

3. The wood is then tarred all over by the ordinary methods.

MESSRS. DAKIN AND CO.'S COFFEE-ROASTING MACHINE.

London, May 13, 1848.
No. 1, *St. Paul's Churchyard.*

Sir,—We observe an advertisement in to-day's *Times*, headed "Fatal Explosion of Dakin's Coffee-Roasting Machine." We beg to inform you that our patent is *in no way connected with anything explosive*, but that the accident alluded to was caused by the blowing up of one of Brown and Company's patent cellular ovens, which we were trying, as a means for obtaining the heat we required to roast coffee. With regard to the specification given in your Magazine as ours, we know nothing whatever of it; it refers, we believe, to the patent above named, and known as "Brown's Patent Cellular Steam Plate." We have, therefore, to request that you will cause the error in the advertisement to be rectified, and that in the next issue of your Magazine, the errors there set forth may likewise be correctly explained to the public. As the evidence before the inquest will be published by that time, you will have full opportunity of doing so.

We remain, yours respectfully,
DAKIN & COMPANY.

To the Editor of the Mechanics' Magazine.

We do not see that we have anything to correct or explain. We stated, in express terms, (*ante* p. 460,) that the unfortunate Mr. Dakin had left his invention *unspecified*, but that it appeared to us, from the accounts in the newspapers, to consist in the application to coffee-roasting of the hot-water plates of Messrs. Brown and Co., *whose specification* we gave at length—not as showing the part of the apparatus invented by Mr. Dakin, but the part of it which exploded. Messrs. Dakin and Co. now tell us, to be sure, that their *patent is "in no way connected with anything explosive!"*—(the italics are their own.) Happy would it have been for their late partner had this only been true. The connection was simply this:—There was a silver cylinder, or a cylinder lined with silver, the invention of Mr. Dakin, which contained the coffee, and revolved within a cellular steam cylinder, the invention of Messrs. Brown and Co. Both were, unquestionably, part and parcel of one apparatus. From the proceedings at the second meeting of the coroner's inquest, which we subjoin, it appears that the proximate cause of the accident was the defective quality of the iron of which the cellular cylinder was composed:

Adjourned Inquest.—Monday, May 15.
(From the *Daily News*.)

Mr. John Farey, consulting engineer, having described the cylindrical power, proceeded to give his opinion as to how the accident arose. It obviously was caused by the water in the oven having a greater pressure than the metal could resist, the metal being at that part exceedingly porous and unsound—honeycombed is the technical phrase.—A Juror: Do you believe, sir, that the iron used in coating the cylindrical oven was the best pig iron?—Mr. Farey: Oh dear no—very bad. In that portion where the fracture has taken place I do not think it is half so strong as it should have been. Portions of it are altogether defective, and contain small grains almost like shot. Three plugs were forced out by the explosion; one of the passages was a little stripped, but not so much as to lead to the impression that it had been forced out before the explosion of the oven itself.

Mr. Renton, foreman to Messrs. Robinson and Co., was called, and corroborated Mr. Farey's evidence as to the cause of the accident in every particular.

The proceedings were then adjourned until Tuesday next. Before the jury broke up, Mr. James said, Messrs. Brown had now in work machinery of the same description on their own premises, and if any of the jury would favour them with a visit the members of the firm would be very happy to explain its mode of operation.

ELECTRIC CLOCKS.

Sir,—I beg leave to acknowledge the politeness of your correspondent, "E. L." in your last Number. I find, however, on referring to the volume of your Journal which he indicates, that the notice of Mr. Wadham's electrical clock is merely copied from a Bath newspaper, and is by no means clear as to the detail. Perhaps "E. L." can inform me where I can see a more minute description.

So far as I can judge from the article in question, Mr. Wadham's contrivance does not seem to possess that peculiar feature of the Rémontoir escapement in which the

excellence of the arrangement, as applied to electric clocks, would consist, that is, a *rigidly uniform* moving force as applied to the pendulum or balance. We are told that the electro-magnet sets in motion a ratchet-wheel, the revolution of which "imparts power to a spring, which not only sustains the original impulse given to the machine, but *accumulates* it." If I understand this rightly, the magnetic force is allowed to bend the spring to a greater extent when in energetic action than when in a weak condition. Now we know that the more a spring is bent, the greater the force which it will exercise in unbending. The defect of this arrangement therefore is, that the source of irregularity is only removed a little further; the spring being irregularly bent up as the moving power varies, exerts a variable influence on the escapement of the clock.

I had foreseen this difficulty, and therefore preferred using a weight instead of a spring; but, upon consideration, I thought that a little contrivance would enable me to apply a compensating arrangement, and thus render practicable the application of the principle to marine chronometers.

I am, Sir, yours, &c.,
W. HISLOP.

City of London Literary and Scientific Institution.—May 16, 1848.

BIRKMYRE'S IMPROVEMENTS IN SMELTING COPPER AND OTHER ORES.

[Patent dated November 16, 1847. Patentee, William Birkmyre, Southdown, Cornwall. Specification enrolled May 16, 1848.]

The improvements which form the subject of this patent relate generally to the smelting of copper, silver, lead, tin, and antimony, but are stated to be more especially applicable to the sulphurets and arsenurets of copper, known as copper pyrites, copper glance, variegated copper ore, and fahl ore, and (but in a minor degree) to peroxide of tin, and the carbonates and oxides of these ores, when contaminated with the sulphurets or arsenurets of copper.

The object of the first improvement described, is to abate the nuisance of the volatilization of sulphur in the state of sulphurous and sulphuric acid, arseneous acid, &c. This is effected by roasting the finely pulverised ore on trays, in an iron pyrites' kiln, by the heat evolved from the combustion of the iron pyrites; afterwards lixiviating; and finally subjecting the ore to the well-known process of cementation, or electro-metallurgy. Full one-quarter per cent. more of pure copper is stated to be thus obtained from "seven and a half per cent." ore; while nearly the whole of the sulphur is saved by converting two-thirds of it into sulphuric acid, and the greater portion of the remainder into salts, by combining the sulphuric acid with the oxides of iron or zinc.

Secondly. Instead of employing a nitrate and sulphuric acid alone in a nitre-pan, the patentee mixes a nitrate, in the same proportion to the sulphur, as before, with the ore upon the tray, and calcines the mixture, so that the nitrate of potash or of soda may, at the same time, supply the vitriol chamber with the deutoxide or other oxide of nitrogen, which is indispensable to the manufacture of vitriol upon a large scale, and oxidate a considerable portion of the sulphur and arsenic, by converting them into sulphates and arseniates of soda or potash.

In carrying out his invention, the patentee employs a pair of ordinary mundic kilns, of an octagon shape, which are on the outside 13 feet long, 7½ feet broad, 9 feet high, and 5 feet diameter inside, and lined with fire-brick. An iron or leaden cistern, filled with water, is placed under the grate, to obviate the temporary nuisance of the sulphuric and sulphurous acid on drawing the mundic ash, the cistern being provided with a sliding top, to prevent the too rapid vaporization of the water. Strong iron bars are fixed inside, above the charging-door, on which rests the tray containing the nitrate and copper ore. An opening is cut in the side of the kiln, to admit of the tray sliding freely in and out with the superimposed mixture. The tray is made of copper or iron, or of iron coated on the top surface with earthenware or porcelain. It is four feet and a half long, and three feet and a half broad, with a rim three or four inches high all round, so that a free passage may be given to the vapours from the mundic through an opening in the top of the kiln into the vitriol chamber. The charging door is furnished with an air-hole and sliding-damper for regulating the admission of air above the mundic, which is most essential to the successful manufacture of vitriol. The air which is necessary for the combustion of the iron pyrites is admitted through the fire-bars of the grate. The vitriol chamber, which is 150½ feet long, 11½ feet wide, and 8 feet high, is divided into three compartments or "bottoms," and each furnished with an apparatus for ascertaining the hourly production and strength of vitriol. This apparatus consists of a stout glass tube, 22 ins. long, which is bent at a right angle at 6 ins. from the end. The short leg is fixed in a half inch lead pipe, previously soldered to an opening in the bottom of the up-turned lead, and the space between the tube and pipe made tight by luting, while the longer one is graduated into inches and tenths. About

a foot distant from each tube is fitted to the bottom of the compartment, a double curved leaden syphon, which is furnished with a mouth-piece and air-hole in the top bend. When it is desired to take an observation, the glass tube is blown down to expel the acid into the chamber, and the depth of vitriol therein contained easily discovered. The air-hole and outlet end of the leaden syphon are closed, and the air exhausted by the mouth-piece; the vitriol then flows and is tested by the hydrometer.

The patentee states that with an apparatus of the dimensions given above, two tons of ore may be calcined, and three tons of vitriol, of the specific gravity of 1·847, may be produced daily.

Ten cwt. of iron pyrites reduced to the size of walnuts, is shovelled into one of the kilns, which is previously lighted, and nearly charged. At the expiration of six hours, the other kiln is similarly charged, and so on alternately. Eight cwt. of mundic ash is withdrawn for every charge of ten cwt. of mundic, of 40 per cent. sulphur, as for every 32 per cent. of sulphur which it loses it gains 12 per cent. of oxygen. The tray is filled with 1½ cwt. of ore, which is spread evenly over it, and occasionally raked, in order that the whole may be equally exposed to the action of the heat. When it is sufficiently roasted, the tray is slid out, and the ore dropped into a leaden cistern, about three feet below the opening, which is supplied with hot water from the cooling cistern, and is slightly acidulated with sulphuric acid to prevent the formation of a sub-salt when precipitating the copper from the sulphate of copper by the use of iron or zinc. The solution is then run into suitable vessels, and the copper precipitated. After which the ore is roasted a second time, and the pure copper obtained.

IRISH REGISTRATION CASE.

QUEEN'S BENCH, MAY 6.

Before Chief Justice Blackburne; Justices Crampton, Perrin, and Moore.

WILLIAM LOWNDES AND OTHERS v. JOHN BROWNE AND OTHERS.

Mr. Whiteside, Q.C., and Mr. Holmes for the plaintiffs, showed cause against a conditional order to set aside the verdict which had been obtained for the plaintiffs at the last assizes for the county of Antrim.

MR. WHITESIDE said, the action was brought under the 5 and 6 Vict., c. 100 (the Designs and Copyright Act), and the plaintiffs recovered the full penalty of £30 for a breach of their copyright. The plaintiffs had intended to proceed for several other penalties for other breaches; but at the suggestion of the judge, intimating that the object was not the recovery of money, but merely to assert the plaintiffs' title, they waived the others. There was one objection made at the trial, viz., that the design was not registered in the names of the plaintiffs as proprietors, it being registered in the names of William and James Lowndes and Company; and it was contended that there was no evidence of the parties constituting the firm.

Mr. TOMB, Q.C., for the defendants, observed, they did not rely on this objection.

Mr. WHITESIDE: Then we proceed at once to the question, and it arises under the third section of the 5th and 6th Vict., c. 100. We registered under the tenth class enumerated in that section. The defendants say we should have registered under the twelfth class. Our design is printed by lithographic ink, and our witnesses swore it was called printing in the trade. The fourth section provides for the conditions of copyright and for the registration.

Chief Justice BLACKBURNE: The textile fabric exists *per se*, then the pattern is impressed, and the ulterior process is sewing or working.

Mr. WHITESIDE: We contend that the objections to the registry cannot be made after the article is registered. The registrar is appointed to register the design according to the Act of Parliament, and if he registers wrong, how can the designer be affected? How can a wrong registry vitiate the right of the plaintiffs? These articles are printed goods, and we fall clearly within the words of section 10.

Judge MOORE: The registrar is to take his instructions from the pattern.

Chief Justice BLACKBURNE: The certificate concludes you.

Mr. WHITESIDE: The certificate is evidence of a novelty of design as well as of other matters, and the analogous case of a patent, Neilson v. Harford. 8 Mees. and Wils. 806, is conclusive. Here is a design, and our specification is under class 10 of the act, and we prove it as an article to which printing is applied.

Mr. TOMB, Q.C., and Mr. ANDREWS, for the defendants, said, that previous to the passing of this Act there had been other statutes passed to protect designs, but without dwelling on them we may at once come to the present Act; and the third section is the important one, "whether such design be applicable to the ornamenting of any article of manufacture." These are the material words. The question is on the word "applicable." We contend it means by printing, or by embroidery, or by sewing.

Judge PERRIN: Suppose the pattern registered under a wrong class, if any other person use that design, is it not an injury to the designer?

Mr. TOMB: If the owner of the pattern have registered wrong, he has no right to maintain his action. He must state the number of the class, and the word "application" shows this—that if the pattern or design to be affixed to the textile fabric be done by printing it comes under one class; if not done by printing, it comes under another class.

Judge CRAMPTON: The design is applied to muslin fabrics; the designer may ornament it either by embroidery or sewing. Is that not within the 10th class?

Mr. TOMB: We contend that the Act of Parliament means the ultimate application of the design. Here the work was done by the needle and by embroidery. Printing means, not the tracing of the patterns, but the permanently affixing that design for the ornamenting the article for sale.

Judge PERRIN: If a man registers his pattern under any class, how can another person use it for another purpose.

Judge MOORE: It would be a strong construction to say, that if the plaintiff registered wrong, you would have a right to use his design.

Judge PERRIN: The Act of Parliament is to protect the design, no matter under what class registered. We say the words in the act, "to be applied," refer to the appearance of the article when presented to the public. There is no intermediate operation. The 3rd section says, "be applicable to the ornamenting of any article of manufacture." That means the ultimate result.

Chief Justice BLACKBURNE: Any application of the design will not aid the defendant.

Judge PERRIN: You should show us that even if the design be wrongly registered, you have a right to use it.

Judge CRAMPTON: Suppose the defendant, instead of applying the design to the ultimate ornamenting, had taken the design by lithographic press, on his woven fabric, and embroidered it, and sold it in that state, would it come within the section? or if by the 7th section there is contemplated an intermediate application, why not an intermediate one in class 10 of the 3rd section? The 7th section says, "during the existence of any such right;" that refers to the right given by the statute, and on the words in the 3rd section the application is for the respective terms therein specified the proprietor should have the right; the common law right is not further interfered with, except as this statute authorizes.

Judge CRAMPTON: You are bound to show us that this is a wrong registration. Does the word "applied" refer to some intermediate step, or to an ultimate result? We say to the latter; this tracery work has nothing to do with the ornamenting.

Judge MOORE: The 7th section prevents you using the copyright.

Judge CRAMPTON: Do not the words "or by any other process by which colours are or may hereafter be produced," throw a difficulty in your way? Those words mean as to the production and impressing of colours, colouring *per se*, either by stamping or some chemical process. The words in the 3d section, "shall have the sole right to apply the same," mean the mode in which the work is presented to the public. The pattern is stamped, and is solely for a guide to the workman. A colour is not produced by sewing, but by stamping. Between each of the classes there is a distinct characteristic; but it is the accident not to be characteristic the plaintiff's counsel wish to substitute.

Chief Justice BLACKBURNE: The court are of opinion that the view of this case taken by the judge at the trial was correct. The intention of the Act of Parliament was to prevent piracy of inventions and to protect the property of the designer. It is plain that the design in the present case was well registered as falling under class 10, which class is sufficiently extensive, and comprehends patterns either of needlework or embroidery. But, whether or not, here is a proper registry, and the omission of that design is protected by the Act.

Judge CRAMPTON: Have the defendants pirated a design from the plaintiffs or not? That question is to be decided by another, whether the registration be good or not? The article is admitted to be a woven fabric composed of cotton, and the design applied by printing, which I admit is not a necessary process, but an intermediate one; but the section says "by any other process," and surely the question is, whether the defendants have not applied the design by a process by which colours are produced on textile fabrics, or may hereafter be produced. My impression is, that the design was intended to be applied by a process which might produce colours on the fabric.

Judges PERRIN and MOORE concurred.

Cause allowed with costs.

WEEKLY LIST OF NEW ENGLISH PATENTS.

(One only Sealed this Week.)

William Taylor, of Birmingham, mechanist, for an improved mode of turning up or bending flat plates of malleable metals, or mixture of metals, by aid of machinery, into the form of tubes. May 18; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
May 15	1448	Alfred Henry Still	Gas Light and Coke Company's Works, Shoreditch	Gas purifier.
16	1449	Robert Linton and John Whitfield	Liverpool	Improvements in the art of cutting and putting together all manner of sails which are set or used on sailing vessels and steamers (jibs excepted.)
17	1450	John Davey Hailes	Linton, Cambridgeshire	Universal orrery globe.
,,	1451	Robert Henry William Bartlett	Epsom	Eye for stair-rods.
,,	1452	Henry Bolt	Birmingham	Portable letter steel-yard.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1294.] SATURDAY, MAY 27, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

SHEPHERD'S PATENT SLIDING AND SELF-FASTENING GATEWAYS, DOORS, SHUTTERS, ETC.

Fig. 1.

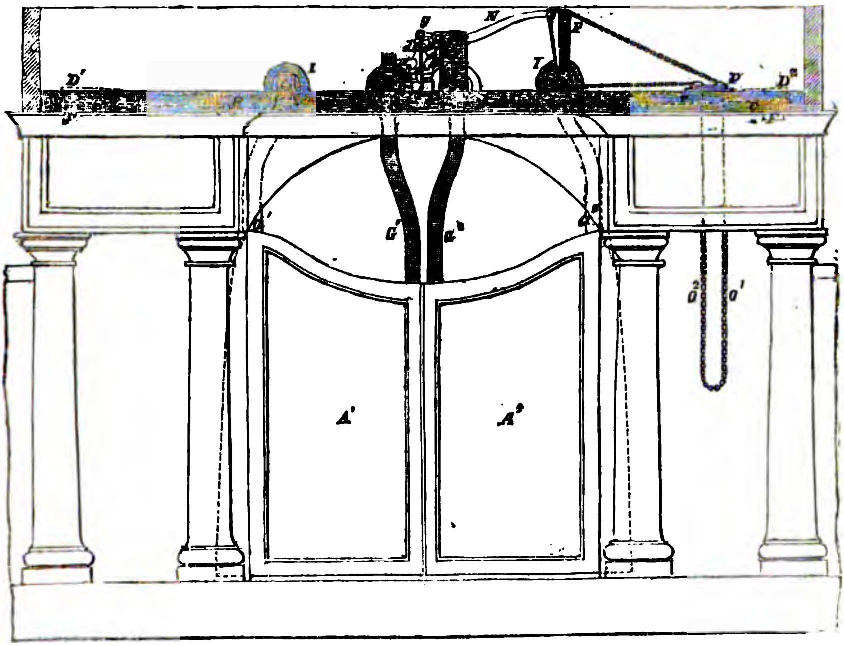
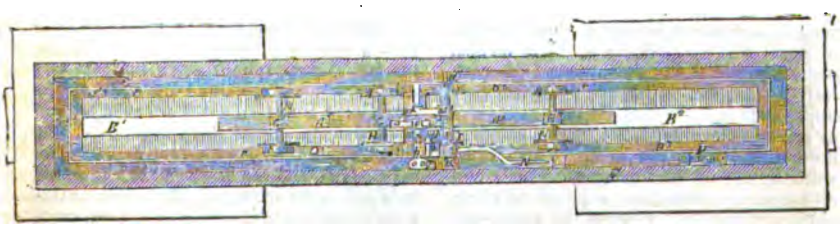


Fig. 3.



SHEPHERD'S PATENT SLIDING AND SELF-FASTENING GATEWAYS, DOORS, SHUTTERS, ETC.

The general principle on which these improved gateways, doors, shutters, &c., is constructed, is that of suspending or pivoting them in such manner, that according as they are inclined to one side or the other, they may, by the mere force of gravity close or fly open, and in the act of closing or opening simultaneously lock and unlock themselves. The idea is a good one, and very cleverly carried out. For carriage-ways in particular, gates on this plan must be superior to all others. We can imagine few better appendages to a country mansion, than a gateway which at the touch of a lever, (which any child or feeble old man or woman can give,) shall fly open before you and shut of itself as soon as you have passed through. We subjoin the ingenious inventor's specification.

Specification.

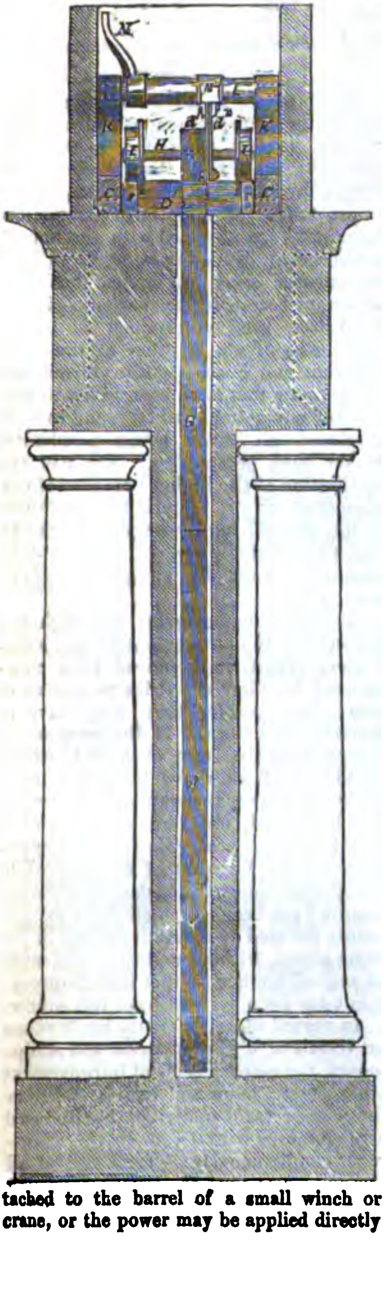
Fig. 1 is an elevation, partly in section, of a gate and gateway, constructed according to my said improvements; fig. 2 is an end elevation, and fig. 3 a plan of the same; A^1, A^2 are the two leaves of the gate, which, instead of turning on hinges, as usual, are withdrawn into two recesses, B^1, B^2, formed in the side-walls of the gateway, when it is desired that the roadway should be left clear; C C is a hollow framework of wood, or metal, which is supported after the manner of an entablature by the two side-walls, and encloses the machinery by which the gates are acted upon. Within this framework there are two platforms, D^1, D^2, which are attached to it by means of pins, E E, upon which, as centres, they are free to move up and down to a certain extent, limited by stops, F F, which form part of the framework C, so as to assume, when required for the purpose of my invention, the position of inclined planes. Each platform carries a set of parallel rails, r, r, r, r, running in a direction at right angles to the line of road; G^1, G^1, G^2, G^2 are four vertical rods, two of which are attached to each leaf of the gate, which terminate at their upper ends in cross bars, H H, which serve as axles to two wheels, I I, which rest and move freely upon the rails. These rods, with the aid of the framework wheels and rails connected with them, support the whole weight of the gate, keeping the same suspended at a short distance clear of the ground. KK are two uprights which support the ends of a cross spindle, or shaft, L, to which are attached two levers, M and N. The outer end of the lever M is attached to the ends of the two platforms, D^1, D^2, by means of two links, or connecting rods, d^1, d^2, and from the outer end of the lever N, there are two cords, or chains, O^1, O^2, carried, which pass over a series of pulleys, P P, so arranged that the one chain shall draw down the end of the lever N, and the other, when similarly acted upon, shall draw it up. From inspection of the figures it will be readily understood, that supposing the chain, O^2, to be pulled downward, the lever N must be drawn downwards from the position it is there represented as occupying, and that this action, by means of the links, d^1, d^2, must lift up the two ends of the platforms, D^1, D^2, which are over the middle of the roadway, and lift at the same time the leaves of the gate along with them; but as the platforms, D^1, D^2, become thus inclined from the level in an opposite direction to that which they previously occupied, that is, towards the recesses in the walls of the gateway, it follows necessarily that the two leaves of the gate, A^1, A^2, will, by the action of gravity run down the rails, r, r, into the recesses, B^1, B^2. A reverse action will of course protrude or shut the leaves, that is to say, by pulling the chain, O^1, it will raise the platforms, D^1, D^2, into their original position, when the leaves, A^1, A^2, will also assume their original position.

The engravings which I have just described include also a representation of my improvements in fastenings as applied to a double-leaved gate: a^1, a^2, are two catches attached to the bars, G^1, G^2; b is a strong spring fixed to one side of the frame C, to the free end of which spring there is attached a catch c, which is so adjusted, that when the gate, or door, or shutter, comes into its proper closed position, it embraces both the catches, a^1, a^2. The spring allows the catch c, to yield to the pressure of the catches, a^1, a^2; but the moment that they have advanced sufficiently close, it comes up into its place, and holds them fast until relieved by the next time the gate-opening apparatus is put into action, when the gate and catches, a^1, a^2, are lifted up clear of the catch c; g is a small lever attached to, and centred upon, one of the uprights, K, one end of which lever is raised and depressed by the shaft L, and the other end is connected by a rod to the spring b. The action of this lever makes surer the liberation of the catch c, from the grip of a^1, a^2, when the gate is raised up, but it is not absolutely necessary, and may be dispensed with.

When the gates, or doors, or shutters, to

be moved are of great weight, then, instead of applying the power directly to the chains, or cords, O^1, O^2, the latter may be at-

Fig. 2.



tached to the barrel of a small winch or crane, or the power may be applied directly to the lever N, which in that case would require to be brought to the outside of the entablature of the gateway.

The power to open the gate may be also applied by means of a platform placed under, or near to the gate, and so connected by a chain, or other means, to the lever or handle N, that the weight of the horses or carriage upon the platform shall bear it down, and move the handle. Or it may be applied by means of a rail or bar, laid across the carriage way at a short distance from the gate, so that the weight of the carriage in passing the rail, or bar, shall move the handle N.

I have hitherto described my improvements in locking and unlocking, shutting and opening, as applied to a gate of two leaves only, but the same principle of action may be made equally applicable to gates, doors and shutters, consisting of one single leaf, by using only one moveable inclined plane, instead of two. And, so also, my improvements in fastenings may be applied, with such slight and obvious modifications as will readily occur to any intelligent workman, to single doors, shutters, and other articles of like construction.

And though, in the accompanying figures, and the preceding description thereof, I have represented the leaves of the gate as being suspended from a framework raised across the roadway, or overhead, and sliding back into masonry raised above the ground, I wish it to be understood, that I do not confine myself to these particular positions; for that the gates may be equally well supported, clear of the ground, by bearings raised from a framework sunk in the ground, and caused to move backwards and forwards in sunken recesses made for the purpose.

ON NAVAL CONSTRUCTION. FROM THE UNPUBLISHED PAPERS OF THE LATE BRIG. GEN., SIR SAMUEL BENTHAM.

Introductory Note.

The immense expense incurred by building ships of new forms for the purpose of experiment, together with the practice induced thereby of attempting many improvements at the same time, instead of confining experiment in each case to one single circumstance, led the late Sir Samuel Bentham to devise means by which useful results might, at small cost, be obtained as to the fittest form and equipment for navigable vessels. In the year 1828, he drew up a statement of his ideas on the subject, which paper he communicated to mem-

bers of the Admiralty Board, to the Comptroller, to the Surveyor of the Navy, and to other branches of administration. In 1830, having made an offer to superintend gratuitously a course of experiments proposed, he was authorized to commence them: the sum of 60*l.* was appropriated to making the requisite models. At the same time, the eminent Mr. Maudslay of that day, without thought of pecuniary compensation, caused some preparatory steps to be taken at his manufactory. Sir Samuel then requested the Navy Board, to point out some suitable person belonging to the dockyard service, to carry on the experiments, but was informed that no one could be spared for this purpose. Mr. Maudslay became ill and died; Sir Samuel was also soon laid up with his last illness, and the experiments, though considered throughout the department of so much importance, were altogether abandoned.

Since that time it appears that the several naval administrations have successively, with a view to the improvement of ships, caused a great number to be built according to the plans of various individuals who have been thought competent to devise improvements, and, in consequence, various ameliorations are believed to have been obtained; yet it does not seem that, even to this moment, any fixed principle has been elicited according to which navigable vessels might henceforward be constructed; at the same time, complaints have been frequent and great as to the heavy expense which has been incurred by the attempts at improvement. These reflections have led to a selection being made from Sir Samuel's papers of the following statements of the course of experiments he proposed, in the hope that at the present day some such measures may be adopted for obtaining the important information in view, which could thus be done without incurring any great amount of expense.

In the papers now selected several items of experiment are omitted; that upon coals for steam-engines, for instance, in consequence of the late successful experiments of Sir H. de la Beche and Professor Playfair. So also in the "Mode of Proceeding" it has not been thought essential to give a variety of details Sir Samuel had entered into. The general principle on which he proposed proceeding should, however, be kept in view—the *saving of useless expense* and the confining each experiment to *one* object only.

May 11, 1848.

Preliminary Observations.

September, 1828.

On reference to late publications relative to the improvement of naval architecture, it will be found to be very generally admitted, that the attempts which have hitherto been made for the improvement of vessels for navigation, have not been attended with the hoped-for success. Experience, far from having cleared away the doubts that have arisen, or reconciled the various opinions that have been entertained as to the superiority of one or other of the many different and even opposite forms and equipments that have been given to vessels for navigation, will be found to have produced on many points perplexity, rather than perspicuity. Nor has the application of the higher branches of mathematics, as yet, materially contributed to the general improvement of vessels, for want, principally, of various data, obtainable only by analytical experiments.

Analytical experiments, although not pursued to the obtainment of any satisfactory result, have indeed been commenced in other countries as well as in this; but, besides that they have in general, been limited to the purpose of ascertaining the form of a body which should meet with the least resistance in being drawn through still water, it has happened, unfortunately, according to the mode of proceeding in these experiments, that for want of due regard to many influencing circumstances, different results have been obtained from experiments directed by different persons to the same object, without notice of the cause of such difference, so that little improvement has been derived from this source.

In regard to experiments made at sea on vessels of different forms and equipments, the many objects of improvement aimed at in planning vessels, whether for war or for commerce, has induced arrangements with a view to the attainment simultaneously of each and of all these objects; thus combination is found in each experiment of so many influ-

encing modifications, that whatever superiority any one vessel may be found to possess while navigating with other vessels, it can never be certainly known to what particular, either as to form, to equipment, or to management, that superiority is owing; consequently, no practical inference can be drawn from any such complicated experiments. This view of the subject has led to the drawing up of the following plan for a course of experiments, in which one particular only should be the subject of each experiment.

(Signed) Samuel Bentham.

Short Statement of the Objects of, and the Mode of Proceeding in, a Course of Experiments, with a view to the Improvement of Vessels for Navigation.

It seems proper to premise, that the term "vessel for navigation" is employed as including every variety of size and shape, from the boat to the largest ship, whatever be the service to which it may be destined, and whatever be the means by which it may be navigated; that it is considered that every vessel for navigation is, according to its size and destination, required to afford sufficient stowage room and accommodation, above water, or under water, for the things and the persons it is designed to convey; while it affords buoyancy equal to the total weight of the vessel itself, with all its contents.

The proposed course of experiments is directed,

1st. To the ascertaining the most advantageous form to be given to the hull of a vessel of any required size.

2ndly. To the ascertaining the most advantageous mode of applying each of the several forces in use for giving progressive motion to vessels; namely, the forces of wind, of steam, and of manual labour.

The experiments on form, relate not only to that part of a vessel which is immersed while floating in still water, but also to all those parts which are liable to different degrees of immersion or emersion, more or less, according to the inclination of the vessel, or by the undulation of the water in which it floats.

The principal objects to which the experiments in the proposed course are directed, in regard to the form of the vessel, are, to ascertain which of the several forms which are or might be given to a vessel of a certain size, will meet with the least resistance to its progressive motion through water and through air, and the greatest resistance to lateral motion, or lee way, and this in an agitated sea, and in an adverse wind, as well as in smooth water. Also to measure and note the degree in which different forms, actual or new, meet with these resistances respectively.

3rdly. To ascertain what are the most suitable appendages to a vessel, as means of preventing her from being driven to leeward, without incurring the inconvenience of giving a great draught of water for this purpose.

4thly. To ascertain which of any of the different forms, being of the same bulk, possesses the greatest stability; that is, which of them affords the greatest resistance to any force tending to incline a vessel, such as the unavoidable action of a side wind; also to measure and note the degree in which each vessel possesses this quality of stability.

As to the size of the vessels on which these experiments are proposed to be made, it seems expedient, with a view to facility and economy, to begin the course with experiments on small models, perhaps not more than three or four feet long; by which, with due attention to the proportionate effects of the different influencing circumstances, great light may be thrown on the subject at a very trifling expense; then to proceed to ascertain the different resistance and stability of real vessels of different forms, progressively from boats to sailing vessels, and ships of the largest dimensions; in all cases, of such forms as previous experiments may have indicated as most promising.

In all experiments relative to the influence of form on the resistance of vessels, it is essential that the weight and the bulk of the subjects brought into comparison, whether models or actual vessels, should be previously ascertained and accurately equalised, so that there should be no other difference in them to influence resistance, but that of the form of the parts exposed to the action of the water or of the air.

By weight is meant the total weight of the vessel, together with its contents and appendages.

By bulk is meant the cubic contents of the vessel and its exterior appendages, both above water and below.

To ascertain the equality of weight of the models or vessels intended to become the subjects of experiments, those not exceeding ten or twelve tons may be weighed by means of various weighing machines in use; and their weight may be equalised by adding ballast to the lighter vessels till they become equal in weight to the heaviest. In regard to vessels of a large size, instead of providing any costly apparatus for weighing these, or of attempting to ascertain their weight by the difficult operation of measuring the solid contents of the parts immersed, the mode proposed by Mr. Walker may be adopted; namely, that of ascertaining the difference of immersion of a vessel when afloat in waters of different specific gravities. Mr. Walker* has not specified the means of ascertaining the difference of such immersion; but it might be accurately measured by means of small perpendicular tubes placed against or through different parts of the vessel, particularly one on each side near each end of it; the water would necessarily rise in these tubes more or less, according to the depth of immersion, which rise in them might be accurately measured by means of a scale fitted with a nonius.

The bulk of the immersed parts of the several vessels the subjects of experiment, may be easily ascertained and equalised, by equalising their total weight, including their contents, supposing always the specific gravity of the water in which they are immersed to be the same.

The equality of bulk of the parts above water of different vessels, can scarcely, in the instance of large vessels, be ascertained otherwise than by measuring the cubic contents of those parts; but in the instance of models their equality in this respect may be perfectly ascertained by noting the weight requisite to immerse them entirely in water of a certain specific gravity.

Experiments on resistance in water and air may evidently be made with equal accuracy, either by holding models or actual vessels still against a current of water or air, moving with a certain velocity, or by drawing them through still water or air; measuring in the one case the resistance by the amount of the weights required to hold the vessel still, in the other by that required to draw the vessel on. In some cases, however, especially for measuring the comparative resistance which different forms meet with in agitated water, the drawing the models or vessels through the water and air by means of another vessel will be more suitable, on account of the facility thus afforded, of giving different degrees of velocity to the motion-giving vessel by means of steam, or by manual labour.

When the object of the experiment is merely to ascertain which of two forms meets with the least resistance in water, let the models—one of each of the two forms to be compared—be put to float side by side, in or near the middle of a stream of running water, both models being attached by lines, one to each end of a bar of wood, say ten feet long; let this bar of wood be fixed by a pin in its middle to a post, pier, or platform, erected in the middle of the current, in such manner as that the bar shall move freely in a horizontal plane, at a certain height, a little above that of the surface of the current. Then of the two models thus attached, it is evident that the one of the form which meets with the lesser resistance will overpower that of the form which meets with the greater resistance, and will consequently be driven lower down in the current, as will be shown by the oblique direction which the bar of wood is thereby made to assume.

When the object is to ascertain, in regard to any given form, the specific degree of resistance which that particular form of vessel meets with, this can only be specified by the amount of the weight requisite to counteract the resistance. Let the model, therefore, be attached to one end of the bar, as above, and to the other end a spring steelyard be applied, or any other such instrument capable of measuring weight in whatever direction it be placed. But perhaps this force of resistance may be measured, most satisfactorily, and with the greatest accuracy, by a common scale-beam and weights, provided a pulley be fixed under one end of the scale-beam, so that the tow-line attached to the head of the vessel may be passed under this pulley,

* See Papers on Naval Architecture, No. 5, p. 77.

and then be fixed to one end of the scale-beam; while the weights requisite to keep the beam in a horizontal position, are applied at the other end. The amount of these weights would then indicate exactly the degree of the resistance.

As to ascertaining the degree of resistance which any vessel opposes to leeward motion, either without or with the various appendages introduced, such as lee-boards, sliding-keels, &c., the same apparatus may be used as in regard to progressive motion, and the experiments may be made in the same manner, excepting that, to ascertain lateral resistance, the vessel must be exposed transversely, instead of longitudinally, to the current, or to the course of the motion-giving vessel.

To ascertain the degree of stability of vessels, absolute or comparative, let weights be suspended to the vessel at certain distances from its middle line by a yard, or other outrigger; then the difference in the weights requisite to incline different vessels to the same angle, will indicate very correctly the different degrees of stability.

(To be concluded in our next.)

NOTES ON THE THEORY OF ALGEBRAIC EQUATIONS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[Continued from page 282.]

Second Series. Note B.

Should any apology be deemed necessary from me for introducing in this place the consideration of equations of the higher orders,* I should advert to the fact that the theory of such equations is so blended with that of equations of the first order as to render it impossible to discuss the latter class with completeness without reference to the former one. This is at least the case so far as the *indeterminate* methods are concerned.† But the intrinsic interest of the subject requires no apology for its introduction here—further than what may be due for any defect of systematic arrangement in these Notes.

It is well known* that, when two quadratics of the second order contain only constant terms and terms involving the squares and the product of the unknowns, then such quadratics may be simultaneously satisfied without our having to solve any equation higher than a quadratic. Let $f^2(x, y, z, p, ., .)$ denote *homogeneous* function of the second degree and of the quantities included between the brackets. Then two such quadratics as those just alluded to may be represented as follows:

$$f_1^2(x, y) = a_1 \ldots\ldots (1.)$$

$$f_2^2(x, y) = a_2 \ldots\ldots (2.)$$

With a slight deviation from the process given in the books referred to in the note (‡) the equations (1.) and (2.) may be solved without transforming them. For, by cross multiplication, we have

$$a_2 f_1^2(x, y) - a_1 f_2^2(x, y) = 0 \ldots\ldots (3.)$$

and the left hand side of (3.) is a homogeneous quadratic function of x and y. Divide this function by y^2, and (3.) will become a quadratic of the first order in $\frac{x}{y}$; and $\frac{x}{y}$ being determined from it, the quantities x and y may be easily obtained, for, their ratio being known, (1.) and (2.) may be written thus

$$ky^2 = a$$

where k is a known quantity, and consequently y may be determined, and x by a similar process, or by means of the equation

$$x = \frac{x}{y} \times y.$$

And similarly the solution of the equations,

$$f_1^n(x, y) = a_1,$$

$$f_2^n(x, y) = a_2,$$

where f^n denotes a homogeneous function of the nth degree of the quantities between the brackets, may be made to depend on that of the "simple"† equation of the nth degree.

Unless two given quadratics are of the forms of (1.) and (2.) they cannot in general be simultaneously satisfied without resolving an equation of a higher

---

* The *order* of an equation is supposed to be fixed by the number of unknowns which it contains.

† See pp. 354, 355, and 357 of the current (xxxii.) volume of the *Philosophical Magazine*.

* "Young's Algebra," (1844,) pp. 165, 166; "Bridge's Algebra," (sixth edition,) pp. 105, 106; "Kelland's Algebra," (1839,) ex. 2 of pp. 150, 151.

† By a *simple* equation I mean an equation of the first *order*.

degree than a quadratic. Let us now see the effect of the indeterminate principle in enabling us to escape the solution of such higher equation, and, for this purpose, suppose that we have given *two* quadratics of the *fourth* order—that is to say, involving *four* unknown quantities.

By applying the Method of Vanishing Groups to the two last mentioned equations we might at once effect their solution without elevation of degree, but I shall proceed to do the same thing by giving an extension to the process employed in the solution of (1.) and (2.) To this end represent, as we are at liberty to do, the two general quadratics between four unknowns by

$$f_1^2(x, y, z, p) + b_1x + c_1y + d_1z + e_1p = a_1,$$
$$f_2^2(x, y, z, p) + b_2x + c_2y + d_2z + e_2p = a_2.$$

Assume that

$$b_1x + c_1y + d_1z + e_1p = 0,$$
$$b_2x + c_2y + d_2z + e_2p = 0,$$

and by means of these last two equations eliminate z and p from the two immediately preceding them: we shall then have two resulting equations of the form

$$f_1^2(x, y) = a_1,$$
$$f_2^2(x, y) = a_2,$$

which, as we have seen, admit of solution by means of quadratics only. Had we adopted the Method of Vanishing Groups, one of the above four quantities would have been superfluous and might have been assumed at pleasure, and we should still have to encounter no difficulty more formidable than the solution of a quadratic. So, in the discussion upon which we are now about to enter, the Method of Vanishing Groups would enjoy a similar advantage.

Before proceeding further I shall show that three quadratics between three unknown quantities admit of complete solution whenever the right-hand side is a number and the left a homogeneous function of the unknowns;—that is to say, when the three quadratics can be represented thus—

$$f_1^2(x, y, z) = a_1 \ldots . (4.)$$
$$f_2^2(x, y, z) = a_2 \ldots . (5.)$$
$$f_3^2(x, y, z) = a_3 \ldots . (6.)$$

By cross multiplication we have

$$a_2 f_1^2(x, y, z) - a_1 f_2^2(x, y, z) = 0,$$
$$a_3 f_1^2(x, y, z) - a_2 f_3^2(x, y, z) = 0.$$

The last two equations are homogeneous with respect to x, y, and z. Divide each of them by z^2 and we shall have two quadratics involving $\frac{x}{z}$ and $\frac{y}{z}$, whence $\frac{x}{z}$ and $\frac{y}{z}$ may be determined by means of biquadratic and a quadratic only; and (4.), (5.), and (6.) will then take the form

$$kz^2 = a,$$

where k is a known quantity. Hence z, and consequently x and y, may be determined.

Let

$$b_1x + c_1y + d_1z + e_1p + g_1q + h_1r = A_1,$$
$$b_2x + c_2y + d_2z + e_2p + g_2q + h_2r = A_2,$$
$$b_3x + c_3y + d_3z + e_3p + g_3q + h_3r = A_3,$$

then we are at liberty to represent three general quadratics of the sixth order (*i.e.* involving six unknowns) by the three equations,

$$f_1^2(x, y, z, p, q, r) + A_1 = a_1,$$
$$f_2^2(x, y, z, p, q, r) + A_2 = a_2,$$
$$f_3^2(x, y, z, p, q, r) + A_3 = a_3).$$

By means of the three equations,

$$A_1 = 0,\ A_2 = 0,\ A_3 = 0,$$

eliminate p, q, and r from the three equations immediately preceding the latter ones. The results will be of the forms

$$f_1^2(x, y, z) = a_1,$$
$$f_2^2(x, y, z) = a_2,$$
$$f_3^2(x, y, z) = a_3,$$

and this last system of equations admits, as we have seen, of complete solution without any other difficulty than that of solving a biquadratic.

The quantities denoted in this paper by $a\,b\,c\,d\,e\,g\,h$, are, of course, all known quantities.

I shall next resume the subject of simple equations and next lay before the reader Spence's solution of a quadratic, and that chiefly for the purpose of illustrating by it his general method; for, the same process is capable of being extended to cubics and biquadratics, and it is one of the general processes of the Theory of Equations.* I have made some change in the notation

* See "Outlines of a Theory of Algebraical Equations, deduced from the Principles of Harriott," &c. by William Spence. London, 1814. For his discussion of a quadratic, see Article II., pp. 5, 6 of his work.

of Spence, and a slight one in his mode of deriving his solution. Let

$$x^2-px+q=0,$$

then Spence supposes this composed of the factors,

$$x-x_1, \text{ and } x-x_2,$$

where I have substituted, for Spence's, the usual notation. He then supposes that we have

$$x-x_1=0, \text{ and } x-x_2=X_2,*$$

in both of which x is the same. Subtract the first of these equations from the latter and we have

$$x_1-x_2=X_2$$

also,

$$x_1+x_2=p$$

hence,

$$2x_1=p+X_2,$$
$$2x_2=p-X_2,$$

and therefore,

$$4x_1x_2=4q=p^2-X_2^2$$

whence X_2 is known, and consequently x_1 and x_2.

I give the following solution merely to show the extension to quadratics of a process by which I have effected the solution of a cubic.†

Let the quadratic be denoted by

$$x^2=px+q,$$

add $\frac{p^2}{4q}.x^2$ to each side; then

$$\left(1+\frac{p^2}{4q}\right)x^2=\frac{p^2}{4q}.x^2+px+q$$
$$=\left(\frac{px}{2\sqrt{q}}+\sqrt{q}\right)^2,$$

whence x may be determined. The expression which we arrive at is

$$x=\frac{\sqrt{q}}{\sqrt{1+\frac{p^2}{4q}}-\frac{p}{2\sqrt{q}}}$$

which may be reduced to the ordinary one. I may remark that the ordinary one is equivalent to taking away the second term of the equation by the method of *transformation*.‡ On the solution of a quadratic, see a useful remark at the place cited below.§

In my *Analysis of the Theory of Equations** I have termed those methods of solution *direct* which proceed without reference to the number of roots of a given equation. The others I have termed *indirect*. EULER's solution of a biquadratic is often† exhibited in a partially indirect form, or, in other words, the final cubic is often formed by means of the doctrine of symmetric functions. But this may, by a process of elimination which will be found at the place cited below,‡ be avoided if it be thought necessary to exhibit the solution under a purely direct form.

In the *Mémoires de l'Académie Royale des Sciences* for 1762, BEZOUT has given *direct* solutions both of cubics and biquadratics. At pp. 23—25 of those *Mémoires*, he reduces a given cubic in x to another in y of the form

$$y^3+h=0 \quad . \quad . \quad . \quad . \quad (7.)$$

y being supposed to be connected with x by the relation

$$y=\frac{x+a}{x+b} \quad . \quad . \quad . \quad . \quad (8.),$$

and the quantities a, b, and h being determined so as to render the co-existence of (7.) and (8.) consistent with the given cubic in x.

So, at page 52 of the same *Mémoires*, he suggests a method of solving a biquadratic by assuming the relations

$$y^3+b=0$$

and

$$y=\frac{x^2+l}{x+f},$$

and determining l, and f, and b so as to render those relations compatible with the given biquadratic in x.

The reader will be pleased to make the following corrections in the first Series of these Notes (*Mechanics' Magazine*, vol. xlvi.):

P. 124, note †, [col. 2] equation (1) *for* × *read* +.

P. 179, col. 1, line 14, *for* √ *read* x.

P. 420, col. 2, line 6 from the bottom, *after the word* but, *add*, either by a direct process of elimination or.

P. 420, col. 2, note *, line 2, *after* of, *add*, vol. iii. of.

P. 422, col. 2, lines 10 and 11 from

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* X_2 is here used instead of Spence's letter b.

† See *Cambridge Mathematical Journal*, vol. ii., pp. 248, 249.

‡ See "Stevenson's Theory of Equations," (1835,) p. 127, 128.

§ Ibid. (Edition of 1832,) p. 53. The result at art. 87 of the succeeding page (54) of that work, will be readily identified with that just obtained. I shall, on an other occasion, remark on the application of the method of p. 53 in solving cubic equations.

* *Analysis*, &c., with Notes, by Professor Davies. *Phil. Mag.*, s. iii., current (xxxii.) vol., pp. 351—367.

† "Stevenson's Theory of Equations," (1835,) p. 136. "Hymers's Theory," &c. (1837,) p. 89.

‡ "Hymers's Theory," &c. (1837,) pp. 13, 14.

the bottom, *transfer the word* this *from the beginning of line* 10 *from the bottom to the beginning of line* 11 *from the bottom.*

The Rock, Stamford, May 19, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 468.)

VI. *Mathematical, Geometrical, Philosophical, and Poetical Delights.*

Origin.—This "Miscellany was introduced to the mathematical part of the inhabitants of this kingdom with a view to turn their attention from that torrent of politics and metaphysics which was overwhelming all the countries of Europe, and carrying down its rapid stream the reason, and more particularly the happiness, of all degrees of society." It was published in half-yearly numbers, and was completed with No. XI., in the year 1798.

Editor.—Mr. Thomas Whiting, Master of Keppel House Seminary, Editor of the "Scientific Receptacle," and Author of "Select Exercises," &c.

Contents.—The contents of the work are—Mathematical Questions and Solutions; Essays on various Subjects; Queries and Solutions; Enigmas, Charades, Rebusses, &c., with their Answers; the whole "Selected from an extensive correspondence." Among the essays may be enumerated—

1. An Essay on the Aurora Borealis, by "Emanuensis."
2. Eulogium on the Newtonian Philosophy, by "Newtoniensis," who also furnished some other papers.
3. An Essay on the Longitude, by Mr. Charles Clark.
4. On the Computation of Eclipses, by Mr. Thos. Milner.
5. Three Letters on Aberration, by different authors.
6. A Short Essay on Mechanics, by Mr. John Bickford.
7. Concerning the Influence of the Moon, by Mr. Olinthus Gilbert Gregory, of Yaxley.
8. An Essay on the Golden Number, &c., by Mr. Wm. Brown, communicated by Mr. O. G. Gregory.
9. A Dialogue between Plato and Diogenes, communicated by Mr. John Williams.

Questions.—The total number of questions is 192; of these 49 belong to Geometry, Geometrical Construction, &c.; 41 to Mensuration and the Application of Algebra to Geometry; 24 fall under the head of Algebra, and in Plane and Spherical Trigonometry there are, in all, 29 questions, many of which are furnished from the abundant stores of Mr. Lowry. The rest are of a miscellaneous nature. No. 85, relating to the area of a curve, was proposed and answered by Mr. Leybourn, whose solution occupies 12 small quarto pages.

Contributors.—This periodical is somewhat remarkable from the circumstance of numbering so many among its contributors who afterwards became eminent in literature and science. I have reason to believe that it contains some of the late Dr. Gregory's earliest efforts in poetry, philosophy, and mathematics. He contributed largely to all the three departments of the work, and, though but 18 years of age, as he informs us in the 35th question, his compositions bear evident marks of his great abilities and varied acquirements. Besides Dr. Gregory, are also the names of Isaac Dalby, author of a "Course of Mathematics;" John Dawes, author of a "Treatise on Fluxions;" William Davis, author of "Land Surveying," and editor of the *Gent. Math. Comp.;* Rev. John Hellins, author of "Mathematical Tracts;" John Hampshire, editor of the *Gent. Math. Comp.;* Thomas Keith, author of "Trigonometry," &c.; Thomas Leybourn, editor of the *Math. Repository;* John H. Swale, author of the "Geometrical Amusements," and editor of the *Liverpool Apollonius;* John Lowry, of the Royal Military College; Armstrong, Colin Campbell, Farey, Fletcher, Knowles, Mabbott, Nicholson; John Riley, of Leeds, editor of the *Leeds Correspondent;* Sanderson, Stevenson; Whiting, the editor; Wolfenden, Taylor, &c.

Publication.—The work was published half yearly, as appears from page 41:—the mathematical, &c., department, for Messrs. Whiting, Davis, Gale, Leybourn, and Kemmish; the poetical, for Messrs. Whiting, Davis, Gale, Glendenning, and Kemmish; and was sold by Mr. T. N. Longman, Paternoster-row, London.

THOS. WILKINSON.

Burnley, Lancashire, May 19, 1848.

*** *Errata.*—In page 467, col. 2, line 13 from bottom, for Davies, *read* Dawes; and *ibid.*, line 6 from bottom, for Abbutt, *read* Abbatt.

CAST STEEL MANUFACTURES.

Sir,—In reply to the inquiries of Messrs. Dean in your No. 1290, respecting "Cast Steel Manufactures," I beg to state that small articles cannot be cast in steel with any degree of soundness or sharpness. The metal sets immediately on being poured into the mould, and is of so susceptible a nature that it shrinks from contact with anything, and would not receive a fine or sharp impression. All cast steel requires to be either hammered or rolled to render it fine and sound in the grain. It is frequently full of small holes, which would be exposed by turning or planing, and in small articles this could not be avoided. The writer once tried to cast some slides for machinery which were difficult to forge, being quite as large as the ingots are usually made. He experienced no difficulty in casting, but when they were planed up, the small holes were exposed and rendered the slides useless. He has made an experiment with a small casting, a part of which is sent herewith;* the round end is in the state in which it left the mould (12 inches of a gun barrel) and the square end has been slightly hammered, but not so much as usual. The whole length before hammering was full of small holes, having no connection with each other; this casting is of a very common quality of steel, but less liable to be *blown* than a better quality would be. I am, Sir, yours, &c.,

A STEEL MANUFACTURER.

Sheffield, May 15, 1848.

CHEAP ELECTRICAL MACHINES.

Sir,—I have tried of late to obtain, if possible, a cheap substitute for glass in making plate electrical machines, and found the following to answer well:

First, I substitute mill-board or pasteboard, cut into a circular form, and smoothed at the edges, upon which I lay successive layers of solution of shellac, until I have obtained it of sufficient thickness. The one layer should be perfectly dry before another is applied. I dissolve the shellac in wood naphtha or pyroligneous acid, without heat, and then apply it to the board with a kind of varnish brush. By this means a perfectly smooth surface can be obtained. Shellac being the best non-conductor of electricity, it is essentially the best substance for producing it. The shocks from it are short, but follow in quick succession, and give pain to the knuckles when held to them—much more so than the shock from the glass machine.

Or, secondly, I substitute for glass, mill-board, coated with a solution of sealing-wax, formed by dissolving the wax in pyroligneous acid, without heat, and then proceed precisely the same as in the preceding case.

The shellac, is, however, superior to the sealing-wax. By either of the above means an electrical machine might be made at a mere trifle, compared with the expense of one of glass, and I should prefer it for strength. The best form of construction is that of Mr. Woodward, viz., having two plates on the same axle; and the expense would be very little more, compared with the increase in power. I am, Sir, yours, &c.,

J. B.

Manchester, May 21, 1848.

SAVING OF FUEL IN GAS WORKS.

At the last meeting of the Royal Scottish Society of Arts, Mr. W. Kemp stated that he had made a valuable discovery in economising fuel at Galashiels Gas Works. Where coal tar is burned, it has an injurious effect on the furnace bars and retorts, the greatest annoyance arising from the rapid clinkering up of the furnace bars, to remove which the firemen had frequently to throw water into the furnace, which caused the rapid destruction of the bars. To prevent this, the idea occurred to Mr. Kemp, of using the exhausted tan bark of the tan works, which had the desired effect. The force pump for injecting the tar into the furnace was next thrown aside, as it was found that the dry bark absorbed tar equal to its production at the works. His method is as follows:—The bark is dried and mixed with the coke of the gas coal, bulk for bulk; a pailful of tar is thrown upon it, not quite so much as it will absorb, and it is then turned over. The mixture burns with a fine clear flame, attended with less smoke than formerly; the furnace bars, by remaining unclinkered, admit the oxygen freely for the combustion of the fuel. Where tan bark cannot be had, peat moss, loose and dry, makes a good substitute. Mr. Kemp stated that, in one year, 126*l.* was saved in furnace coal.

* Which any person interested in the subject may inspect at our office.—ED. M. M.

REID'S PATENT ELECTRO-TELEGRAPHIC IMPROVEMENTS.

[Patent dated November 23, 1847. Patentee, Mr. William Reid of University-street, Engineer. Specification enrolled May 23, 1848.]

Fig. 2.

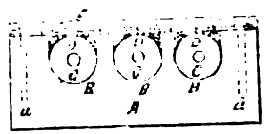


Fig. 1.

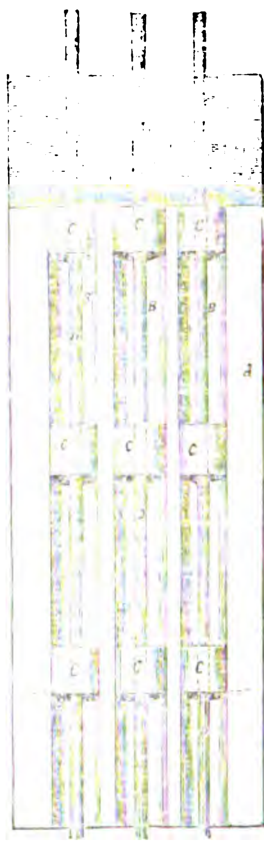


Fig. 3.

The improvements comprehended under this patent, have, *firstly* for their object, "the better insulation and protection of the wires employed in communicating intelligence by electricity." Instead of employing, as usual, wires covered with zinc or cotton, and supporting them on poles at a considerable height above the ground, Mr. Reid lays them in a plain or uncovered state in well-protected channels, made for them under the ground or flush with the surface of the ground, and there insulates them by means of earthenware supports, or carriers, and covers them in with marine glue or gutta percha, or asphalt, or Stockholm tar, or some other resinous substance or composition.

We quote the following details from the patentee's specification:

Figs. 1, 2, and 3, represent a portion of a triple line of wires laid down on this improved plan. A is one of a continuous line of wooden sleepers which are joined end to end by half checking, as shown in fig. 3 (side view), and laid in a trench made in the ground. To prevent water or damp entering at the oinings, I insert at those joinings, washers of gutta percha or vulcanised caoutchouc. BBB, are three deep parallel grooves cut out on the upper surface of the sleeper; CCC, are annular supports or carriers made of earthenware or gutta percha, which are fitted into the grooves at distances of from six to twelve or more feet apart, and are of a diameter equal to the depth of these grooves; DDD, are the wires which are passed through the carriers, C, and upheld by them, so as to be kept quite free from contact with the sides of the grooves. The wires having been so laid, the vacant spaces in the grooves are filled up with marine glue, or gutta percha, or asphalt, or Stockholm tar, or any other resinous substance, which is poured in, in a warm and fluent state. The wires become thus entirely surrounded by or imbedded in waterproof and non-electric conducting materials, and thereby permanently protected from all disturbing influences. E, is an iron cover or shield, which is laid over the whole, and made fast to the wood by screws, *a a*, while the marine glue, or gutta percha, or other resinous substance is in a fluid state. The wires may of course be of any number more or less than three; the number and proportions of the other parts being varied accordingly. Instead also of the sleepers being of wood, they may be made of artificial stone, or concrete, or earthenware, and in that case the earthenware annular carriers, C, may be dispensed with. The vacant spaces in the grooves may be also left unfilled up, and the access of water excluded by laying washers of

gutta percha, or vulcanised caoutchouc, or felted cloth, between the edges of the shield and the sleepers, as shown at *z*, in fig. 2 and 3.

A modification of the preceding plan is represented in figs. 4, 5, and 6. A, fig. 4,

Fig. 4.

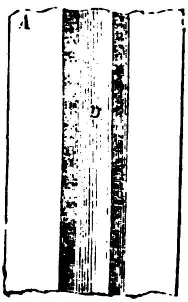


Fig. 6.

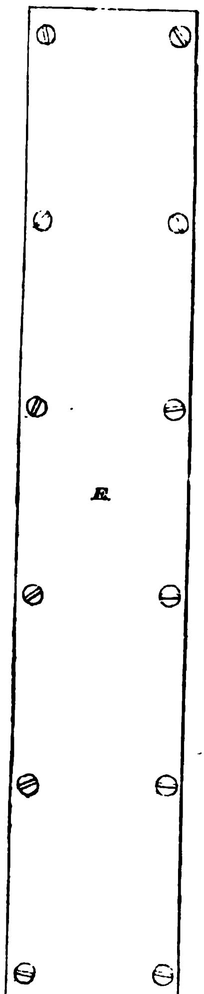


Fig. 5.

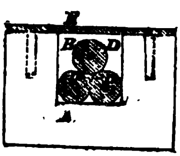


Fig. 7.

is a wooden sleeper as before; B, is a square groove in the upper surface of the sleeper, in which are laid the three (or any other number of) wires DDD, which are first covered with cotton in the usual way, and then inclosed in lead tubes; each wire being thus insulated by the cotton wound round it from the tube in which it is inclosed, and the three wires being kept by these tubes separate from one another. The vacant spaces in the groove may be either filled up, as in the preceding case, with marine glue, or gutta percha, or asphalt, or Stockholm tar, or other analogous material, or left unfilled, as the lead tubing in which the wires are inclosed will insulate them sufficiently from one another, and from the wood of the sleeper. E, is an iron shield to be made fast by screws as before, to the wooden sleepers. When the groove, B, is not filled up with marine glue, or other resinous substance, I interpose between the shield and the top of the groove a washer of sheet gutta percha, or vulcanised caoutchouc, or felted cloth, in order to make the groove water-tight at the edges.

Or, instead of the arrangement which has been just described, the three (or any other number of) covered wires may be placed in tubes of iron, or stone, or concrete, laid under ground, or flush with the surface, as represented in fig. 7.

Fig. 8.

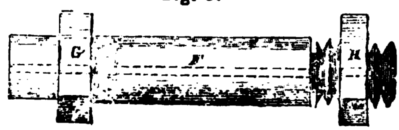
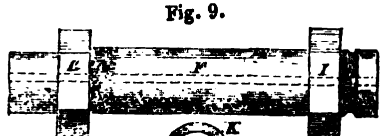


Fig. 9.



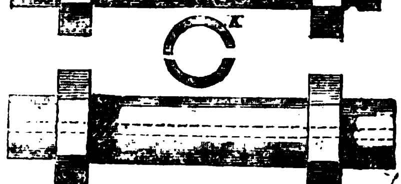


Fig. 10.

Fig. 11.

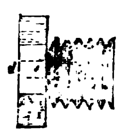


Fig. 18.

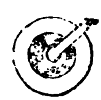


Fig. 19.

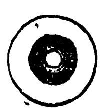
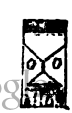


Fig. 20.



Where it is necessary, from local peculiarities, still to adhere, in parts of an electro-telegraphic line, to the mode of carrying the wires or poles at a height more or less above the ground—as, for instance, in passing through tunnels, or crossing bridges, where the wires are much exposed to damp—I adopt earthenware insulators of one or other of the improved forms represented in figs. 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20.

The insulator shown in fig. 8 consists of an earthenware tube, F, with a flange, G, at one end, and a loose collar or nut, H, at the other, which last is screw-threaded on the inside, and turns on a male screw formed on the H end of the tube. The loose collar, H, being first taken off, the tube is passed horizontally through a hole, in the top of one of the ordinary upright posts, and then made fast in its place by putting on the loose collar, H, and screwing it up tight.

Fig. 13.

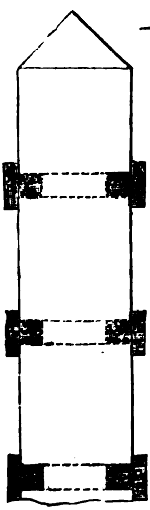


Fig. 15.

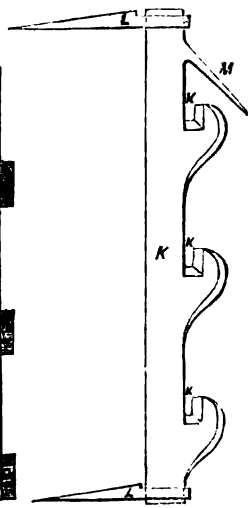


Fig. 9 shows an insulator which differs from the preceding, in not being made fast by screwing. G is a fixed flange on one end of the tube, as before; I, a plain, loose collar, which is slipped over the opposite end of the tube, after it has been passed through the post; and K, a split metal ring, which, being expanded by hand, and dropped into the groove, *b*, behind the collar, I, prevents its return, and thereby makes the tube fast.

Another mode of fixing a loose collar similar to that employed in fig. 9, is shown in fig. 10. The tube is formed with a slot in it at the loose-collar end, and when the collar has been slipped over the tube, it is

Fig. 23.

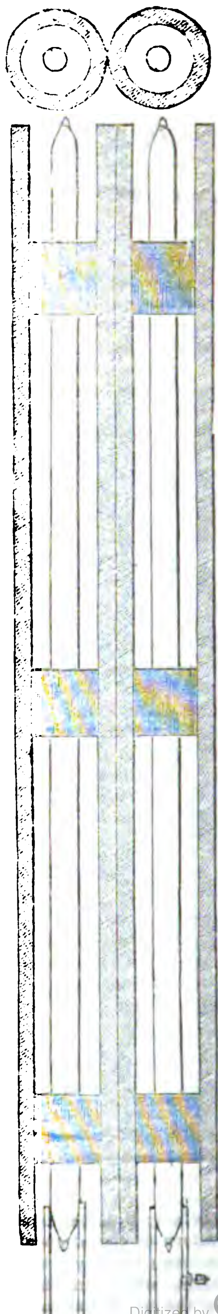


Fig. 21.

Fig. 22.

made fast by inserting a pin, b^2, into the slot.

Fig. 11 represents another form of insulator, suitable for inserting in pairs opposite the one to the other, in upright posts, as represented in fig. 13 (side view.) It consists of a head-piece and shaft, which last is screw-threaded, and screwed into the post. The orifice, *d*, through which the wire is passed, is made to taper inwards to a diameter just sufficient to allow the wire to pass, so that any water or moisture which may collect in the orifice, flows necessarily down its under inclined side, *e*, and is so carried off. A passage is bored out of the wooden post between each pair of these insulators, of size sufficient to exclude any chance of the wire coming in contact with the wood.

Fig. 15 is a side view of an insulator, suitable for sustaining the wires when carried along the sides of walls, as in tunnels and bridges. K is a round post, made of earthenware, with projecting side rests, *k*, *k*, *k*, in which the wires are laid; LL are staples, which are attached by eyes to the post, at top and at foot, and driven into the wall. M is a roof-piece, which projects, in a slanting direction, considerably beyond the side rests, *k*, *k*, *k*, and serves to protect them from wet.

Figs. 16 and 17 are front and side views of an insulator, which differs only from the preceding one in being flat instead of round. (These figures it is unnecessary to give.)

Fig. 18 represents an insulator suitable for occasional or temporary use, being so constructed that it can be applied to the wires after they have been passed through the wooden posts, and offering, therefore, a convenient substitute for any of the insulators previously described, when they happen to get broken by accident. It consists of a disc, with two conical holes bored in it from the opposite sides, and meeting in the centre. It is slipped on to the wires by the opening, *m*, and then inserted in the hole in the post.

Fig. 19 represents an insulator of the same form as fig. 18, but without the opening, *m*.

Instead of employing earthenware insulators of the improved forms before described, I sometimes employ insulators made of gutta percha, which may be firmly fastened in the holes of the posts by mere adhesion of surfaces, without the aid of either screws, or collars, or nuts. Fig. 20 represents an insulator of this description. It consists of a ring, or small cylinder, of solid gutta percha, with two conical holes, *o*, *o*, bored in it from the opposite sides, and meeting in the centre. Before inserting it in the hole in the post (which it should fit pretty exactly,) it is slightly warmed, and dipped in a warm solution of gutta percha, which causes it to take a firm and lasting hold of the wood. These gutta percha insulators may be fixed still more securely by making them on the exterior, of a square, hexagonal, or some other polygonal form, and making the holes in the posts of a corresponding shape; but I prefer the circular form, as being attended with the least expense, and as furnishing as much security as is needful.

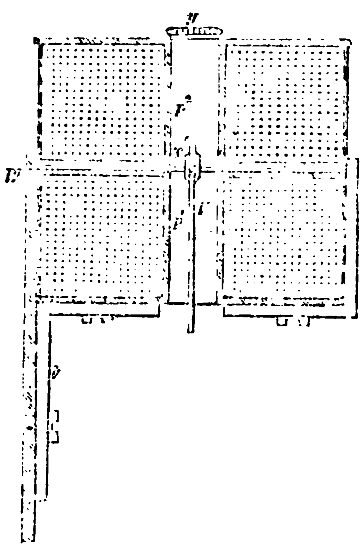
Gutta percha may also be substituted for earthenware, in the case of the insulators represented in figs. 15, 16, 17, 18, and 19; but in figs. 15, 16, and 17, instead of employing projecting side rests for the wires, I make notches or recesses for their reception in the body of the insulator.

A *second* class of improvements comprehended under this patent, have for their object, 1st., "to furnish a readier means than now exists of establishing the circuit of communication between the guard and the driving engine and intermediate carriages, and of detaching from, or adding to that circuit, any carriage, or number of carriages, as circumstances may require;" and, 2nd., "to ensure the sounding of the bells, or other alarums employed, with greater certainty than the means now ordinarily used afford."

The first of these objects I effect by means of the following arrangement:—Each carriage of a railway carrying establishment has two tubes permanently affixed to the top of it, side by side; and these tubes contain each an electric-conducting rod, which is sustained and insulated within it, by means of earthenware or gutta percha insulators of the form represented in figs. 19 and 20, and before described. These conducting rods project slightly beyond the containing tubes at both ends. Between the back end of each rod, and the front end of that next behind it there is placed a short metal tube, into which the two ends are inserted and retained by means of springs attached to them, but not so fast, but that they may be withdrawn from the tube one or both of them by the application of a very slight force. The tube turns at the centre on a universal joint, so as to adapt itself readily to any deviation of the railway train from a straight line. It has also two chains pendent from it, by which it may be connected either to the carriage in front, or to that behind, (but not to both at the same time;) so that, supposing the ends of both rods to be withdrawn from it, it may be kept from falling

to the ground and remain at hand ready for use. A plan of one of the rods detached from its carriage is given in fig. 21; *n*, *n*, *n*, are the springs (of which one only is fully seen in the engraving) which are attached to it by screws, *s'*, *s''*, the latter of which is passed through a slot in the spring to allow of the spring having the necessary play. A longitudinal section of one of the connecting tubes is also given separately in fig. 22; *q* is the universal joint, and *r*, *r*, the fastening chains. Fig. 23 shows the whole of the parts in their places, and as connected together in a series of railway carriages. Supposing any one of the carriages to be withdrawn, then immediately on those in the rear closing up, the front end of the rod of the headmost of the rear carriages enters the end of the tube which was previously occupied by the front end of the rod of the withdrawn carriage, and thus re-establishes a continuous line of metallic communication from one end of the line to the other; and so also, on an additional carriage or any number of carriages being interpolated into a train, the line of metallic communication is broken and renewed for the purpose, by a mere shifting or transposition of the connecting rods.

Fig. 26.



The second object embraced under this branch of my invention is effected by the substitution, with modifications, of an ordinary galvanometer for the electromagnet and armature now employed to sound the bell or other alarum. Fig. 25, exhibits a front view of an apparatus, in which are combined the galvanometer modified as aforesaid, with the ordinary clock-work and bell. Fig. 25*, is a top plan of the galvanometer, and fig. 26 is a section of it through the centre. The galvanometer is made of the usual oblong form, but in two separate pieces, P^1P^2. The under-piece, P^1, is first affixed by two brackets, *t t*, to the front plate of the clockwork apparatus. A horizontal axis, *x'*, is then placed in a groove which runs across the centre of the piece, and is supported at the two ends by brackets, *w w*, as shown in fig. 26. On this axis there is poised in a vertical position a permanent steel magnet, V, which is represented in the figure as being bent into an S form, but may be of a semicircular or straight, or any other form which admits of the magnet being easily poised on its centre. The upper piece, P^2, is then placed upon the other, and made fast to it by means of the steady pins, *x x*, and nuts, *y y*; this upper piece having also a groove across the centre of it, corresponding with that in the under piece, so as not to interfere with the axis of the magnet. By holding up the galvanometer in this way, the axis and magnet can be adjusted with great facility and nicety; and when any readjustment of them is required, this also is very readily effected by undoing the nuts, *y y*, and taking off the top piece, P^2. Upon an electric current being transmitted through the connecting-rods and tubes of the carriages to the galvanometer, the magnet, V, becomes instantly deflected in a direction at right angles with the current of electricity, and strikes against a lever, W, which puts in motion, by means well understood, the clockwork which strikes the bell or other alarum. I prefer that the galvanometer should be of an oblong form, as represented in the figures, but it may also be made of a circular, or oval, or of any other convenient form. The plan of making the galvanometer in two pieces, may also be applied with advantage to the construction of the coils used for signalising purposes in the ordinary electro-magnetic telegraphs.

Mr. Reid's claims are as follows:

First. I claim the modes of laying, insulating, supporting, and protecting electro-telegraphic wires, severally represented in figs. 1, 2, and 3, figs. 4, 5, and 6, and fig. 7, each in the peculiar arrangement, adaptation, and combination of parts of which the same consists; but I disclaim the use of grooved wooden sleepers, except as forming parts of such combination, being aware that it has

Fig. 25.

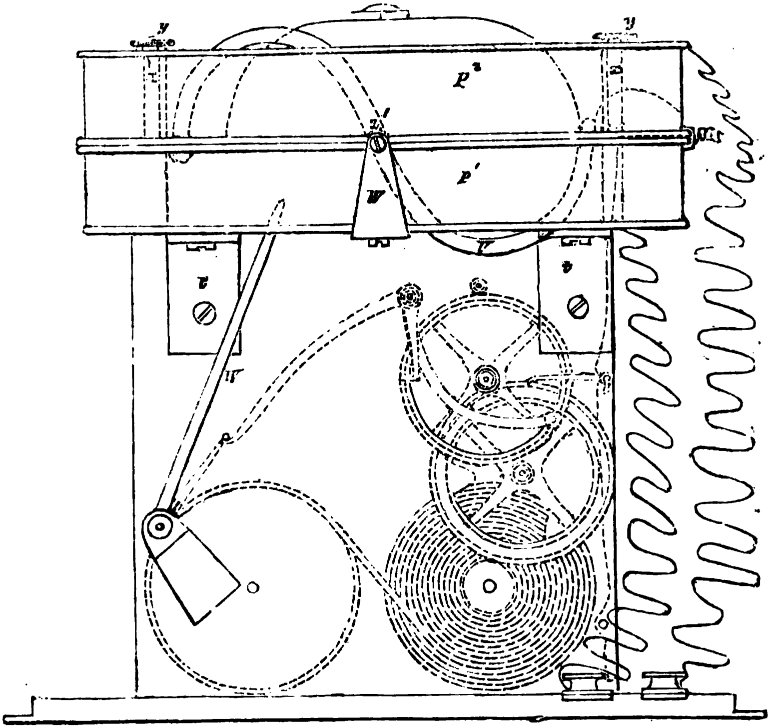
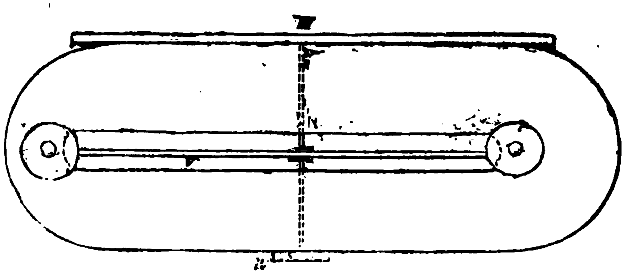


Fig. 25*a*.



been before proposed to lay the wires in channels formed in rails of wood.

Second. I claim the employment, for the purpose of communicating intelligence by electricity, of earthenware insulators, of the different forms represented in figs. 8 to 19, both inclusive.

Third. I claim the employment of gutta percha as a material for the supports or carriers to electro-telegraphic wires, as before exemplified and described; but disclaim the use thereof for the mere coating or covering of the said electro-telegraphic wires.

Fourth. I claim the peculiar mode or

modes of establishing, disconnecting, and re-establishing electro-telegraphic communication in railway trains, described under the second general head of this specification.

Fifth. I claim the employment, for the purpose of sounding bells and other alarums employed in electro-telegraphic communications, of the ordinary galvanometer, modified as aforesaid, and combined with the clock-work and bell or other alarum usually employed.

And, *Sixth*, I claim the constructing of the coils used for signalling purposes in electro-magnetic telegraphs, in two parts, as before described.

GALVANIZED OR ZINCKED IRON, WELDABLE.

Mr. James Nasmyth, C. E., in a letter to the *Mining Journal*, gives the following account of the results of some experiments which have been lately made, at the desire of the Lords of the Admiralty, by their "Committee on Metals," for the purpose of ascertaining whether the galvanizing of wrought iron, by a coating of zinc, has the effect of preventing such galvanised articles from being re-manufactured.

"With a view to put this question to the test of experiment in the most severe manner, a piece of *galvanized iron wire rope* was welded up into a bar, and put to the most severe test. In the first place it was found, that although the iron wire was quite covered with metallic zinc, which, although partially driven off in the process of welding, yet, so far from the presence of the metal, or its oxide, presenting any impediment to the welding of the iron, (as in the case of lead,) the iron wire welded with remarkable ease; and the result was, a bar of remarkably tough, silvery-grained iron, which stood punching, splitting, twisting, and bending, in a manner such as to show, that the iron was not only excellent, but, to all appearance, actually improved in quality in a very important degree.

"Encouraged by such a result, a still further, and even more severe, trial was made—viz.: by welding up a pile of clippings of galvanised iron plates, or sheet iron, covered with zinc, as in the former experiments. The presence of the zinc appeared to offer no impediment to the welding, and the result was, a bloom or bar of iron—the fracture of which presented a most remarkable and beautiful silvery grain—as good, if not superior, in aspect to the very finest samples of "Low Moor" or "Bowling" iron. Blooms of this iron were rolled out into rods, and tested in the cable-proving machine, and the result indicated from 5 to 10 per cent higher strength than the best samples of wrought iron—thus establishing the fact, that, so far from the presence of zinc being destructive to the strength and tenacity of wrought iron, the contrary is the case.

"I may mention, that bars of iron were heated to a welding heat, prepared for sheathing, in the usual manner; and, on drawing them from the fire for being welded, a handful of zinc filings was thrown on the welding hot surface, and the welding proceeded with. In this severe test no apparent impediment to the process resulted; the iron welded as well as if no zinc had been present. Judging from the appearance of the iron welded up from 'zinc-covered iron scraps,' not only as respects its clear silvery aspect, but also the increased strength which such exhibited under proof, it may not be unreasonable to infer, that some important improvement might be made in the manufacture of iron by the actual introduction of metallic zinc in some one or other of the stages of its manufacture—such as in the puddling-furnace. What the nature of the action of the zinc is, we are not yet able to say; all we as yet know is, that, so far from being prejudicial to the quality of the iron, it appears to have rather an improving effect; and that to such an extent as to cause us to desire that the subject may receive the attention of some of our intelligent iron manufacturers, so as to put the matter to the test of actual experiment in the puddling-furnace, or any other stage of the process, such as may appear to promise the best results.

"I may name a curious corroborative fact,—that the strongest cast-iron made in Belgium, and selected for the casting of guns, is made from an iron ore, in which the *ore of zinc* forms a considerable portion. Whether the superiority of this iron is due to the presence of zinc, is a question; but the result of the before-named experiments tend to lead to the supposition that such may be the case."

RECENT AMERICAN PATENTS.

[Selected from the *Franklin Journal*.]

IMPROVEMENTS IN FIRE AND OTHER ENGINES FOR THROWING WATER. *Charles W. Grannis.*—"It is well known that in fire and other engines for throwing water, the air vessel into which the water is forced on its way to the discharge pipe, for the purpose of equalizing the discharge, by the elasticity of the air contained, is liable to a serious objection, viz.:—that of mixing the air with the water, which causes the column of water to break into spray on leaving the

discharge pipe, and that if the engine be kept at work for any considerable length of time, all the air is discharged from the vessel. This defect arises from the imperfect manner in which the air vessel is connected with the cylinder and discharge pipe, in such manner that all the water has to be forced through the air vessel.

"The nature of my invention, devised for obviating this difficulty, consists in placing the air vessel of a double-acting engine between the two branch pipes which form the connection between the two ends of the cylinder and the discharge pipe, and connecting the air vessel with them by means of pipes inclining upwards from the air vessel to the branch pipe, or rather inclining in the direction of the discharging current, by means of which that violent agitation which takes place within the air vessel on the usual plan is entirely avoided, the outward current being without the vessel, whilst the body of air within the vessel is pressed on either side by the pressure of the water. This constitutes the first part of my invention.

"It is a well-known physical law, that all fluids issuing from a vessel through an aperture, take a rotary motion, and hence the difficulty of throwing a solid unbroken column of water—a result admitted to be very important. This whirling motion of the water is necessarily due to the force applied, and by that much reduces the distance to which the column would otherwise be thrown. The object of my second improvement is to avoid this whirling motion, and at the same time save the power thus consumed, and consists in providing the bore of the discharging nozzle or pipe with wings parallel with, and converging to, the axis of the bore, whereby the column is divided into as many parts as there are wings, and the rotation of the water prevented."

Claim.—"What I claim as my invention is, arranging the air vessel of double-acting force pumps between the two eduction or branch pipes, when the connection is formed by means of two pipes, inclining from the air vessel to the branch pipes in the direction of the issuing columns, as described, whereby the discharge of air from the vessel is effectually prevented, and the elastic force of the air exerts a more direct force on the column of water at the end of the stroke of the piston than by any known arrangement.

"And I also claim the employment of a wing or wings within the bore of the nozzle or discharge pipe of fire and other engines for throwing water, as herein described, by means of which the whirling motion of the stream is prevented, and a more solid column obtained than by any other known method."

Improvements in the Furnace for the Manufacture of Articles of Iron. *William H. Passmore.*—The patentee says, —"For the purpose of heating scythes and other articles of a like character up to the proper degree for hardening, the general practice heretofore has been to take them in their cold state, and to pass them over the fire in a heating furnace constructed for that purpose, taking care to heat them as equally as possible in every part; but as scythes, swords, and other articles, having a cutting edge, are unequal in thickness, their thinner parts are the most quickly heated, and are liable to be injured from this cause before their backs or thicker parts are sufficiently heated for hardening. To guard against this result, it has been necessary to heat them slowly, which is necessarily attended with much loss of time, whilst, after all, the evil is but partially corrected. In my improved heating furnace, I employ a case or oven of cast iron, for the purpose of heating the scythes or other articles, previously to their being passed over the fire in the ordinary heating furnace; and in this case or oven I bring them to such a degree of heat as will enable me to complete the heating in the ordinary furnace with great rapidity. As the preparing oven contains a considerable number which are necessarily placed within it, they have ample time to allow their thicker and thinner parts to be brought up to the same degree of heat."

Claim.—"Having thus fully described the construction of my improved furnace for heating scythes and other articles to be hardened, what I claim therein as new is, the combination of the preparing case or oven with the heating furnace heretofore employed with said preparing oven, being formed and combined with the furnace, substantially in the manner and for the purpose set forth."

For an Improved Engine, operated by the Explosion of Gases. *Stuart Perry.*—"My first improvement consists in surrounding the cylinder of the engine with water, to carry off the heat generated by the explosion of the gases, and keep it at a sufficiently low temperature for the efficient action of the engine, and at the same time, in certain cases, to employ this surrounding water as a water bath for the retort which generates the inflammable gas, when the gas is generated from a liquid or liquids, the heat generated by the combustion of the gases being sufficient to keep the water at the temperature required for generating the gas, whilst the water carries off the heat from the cylinder, to prevent its

being overheated. My second improvement consists in lubricating the piston and the inside of the cylinder with water, which not only prevents the wear of the parts, but at the same time aids in preventing these parts from being overheated. My third improvement consists in lubricating the piston rod, and preventing it from being overheated, by surrounding it with water at or near the stuffing box. My fourth improvement consists in a new method of inflaming the gases, by platina heated by the heat of inflamed jets of gas and air from the retort acting thereon; the platina being so situated as to communicate by a valve or valves directly with either end of the cylinder, or with the passages through which the mixed gas and atmospheric air pass to either end of the cylinder. And my fifth improvement consists in the employment of a receiver containing condensed atmospheric air for starting the engine, in combination with another receiver, and with an air pump, by means of which atmospheric air is forced for the continued working of the engine, the said air pump being operated by the engine."

For an Improved Process for Toughening the Hull or Outer Covering of Wheat and other Grain, preparatory to converting the Grain into Flour. *J. W. Howlet and F. M. Walker.*—"The nature of our invention consists in passing the wheat or grain through a current or jet of steam, in any convenient manner, so that each kernel of grain shall be thoroughly acted upon by the steam, which gives to the hull such strength and tenacity that it is not pulverized by the action of the stones in converting the grains into flour, and thereby specking and deteriorating its quality, but is peeled off the wheat in large flakes."

Claim.—"The utility of toughening the hulls of the grain in some way previous to grinding, and also the difficulty of effecting this desideratum uniformly, is well known to practical millers. When grain is ground in too dry a state, the hull is so tender and brittle that a portion of it is pulverized and passes through the bolt with the flour, disfiguring its appearance, and greatly reducing its merchantable value. What we claim as our invention, is, the method or process of toughening the hulls of wheat and other grains, preparatory to grinding, by the application of steam, substantially in the manner and for the purpose as herein set forth."

For Improvements in the Steam Engine. *N. N. Barlow.*—"In the steam engine as now constructed, the piston must be accurately fitted to the cylinder, and packed; the cylinder is then provided with a head or cover, accurately fitted and bolted, and provided with a stuffing box around the piston rod; and then the end of the piston rod, where it receives the connecting rod, is either provided with a sliding head working on ways, or with a parallel motion, which are not only very expensive, but either of these modes occupies much room; for there must be, between the upper end of the cylinder and the beam or other connection, room sufficient for the length of piston and connecting rods, which, in many instances, is a source of great inconvenience, as, for instance, in steamboats.

Many of these objections I avoid, and render the engine cheaper and less liable to derangement, by making the piston a long hollow cylinder, the outer diameter of which fits, either accurately or loosely, the inside of the steam cylinder, the upper end of which is provided with a stuffing box which surrounds the hollow cylindrical piston: that is, therefore, made of greater length than the steam cylinder within which it works, thus avoiding the necessity of a packed piston. The inner end of this piston cylinder is closed to form the piston head, and to the inner surface of it is attached the connecting rod, which extends to the crank. By this arrangement, the unequal wear of the piston and cylinder by the vibrations of the connecting rod is avoided. The steam, of course, in this arrangement, can act only in one direction, and therefore will be only single-acting; but when it is desired to make a double-acting engine, then two such single-acting engines are so arranged as to be connected together by a crank shaft, having two cranks on opposite sides of the axis, so that the moment one ceases to act the other commences, the valves alternately opening and closing the induction and eduction valves.

"It will be obvious that this engine may be single-acting by having but one cylinder and its appendages; double-acting, as above described; threefold-acting, by having three cylinders with the cranks, making an angle of 120° with each other, so as to divide the circle into three equal parts, the threefold-acting being the best for working the steam expansively, by means of cut-off valves, as the steam will at all times be acting with its full force in one, and expansively in another.

"By constructing an engine on this plan, but one packing will be required for each cylinder, and that a stuffing box which admits of adjustment much more readily than a piston, which can only be repacked by taking the engine apart. It dispenses with the necessity of a sliding head or parallel motion, the cylindrical piston performing that office by having the connecting rod jointed to it within and at the bottom, at the same time saving the room occupied by

the piston rod in the common engine; and what is of great importance, the piston can always be kept oiled by simply oiling the stuffing box, which is not the case in engines as heretofore made."

FOR IMPROVEMENTS IN THE MANUFACTURE OF GAS. *George Michaels.*

Claim.—"I claim the employment in the manufacture of gas from anthracite or other equivalent, for the purpose of lighting or heating of a *closed* furnace, (constructed and combined with a gasometer,) and streams or jets of heated steam and air forced into the charge thereof in a state of combustion.

"I also claim the increasing the illuminating power of the gas, (generated as above,) through the agency of oil or turpentine, or other equivalent matter, by causing the gas to pass through the olefiant fluid, and be impregnated by it.

FOR IMPROVEMENTS IN THE MANUFACTURE OF SUGAR FROM CANE OR OTHER PLANTS. *George Michaels.*

Claim.—"I claim cutting the canes or plants transversely through their saccharine cells, and into very thin slices, immersing them in hot water, and rendering insoluble and inert, during the process of dissolution, such chemical substances of the cane as would otherwise exert an injurious influence or chemical action upon the saccharine matter.

"I claim the use of oxalate of alumina, for the purpose of exerting the necessary chemical action upon the aforesaid combination of syrup; chlorophyle, and the superabundance of lime, in order to remove these two substances, and particularly the lime, that extraneous chemical matter used to render inert these substances, which would otherwise prove injurious to the sugar during the process of its dissolution from the cane."

FOR AN IMPROVED CRIMPING TOOL, FOR CRIMPING BOOTS. *William Taylor.*—The patentee says,—"The nature of my invention consists in causing the leather to conform to the shape of the crimp, by forcing the latter, after the leather has been applied thereto, between two smooth iron jaws of peculiar shape, the interval between said jaws being regulated by a screw; a second screw acting against the heel of the crimp, and serving to thrust the instep thereof, and the parts adjacent thereto, between the jaws."

FOR AN IMPROVEMENT IN CARRIAGE STEPS. *David and E. Z. Little.*—The patentees say,—"The nature of our invention consists in causing the steps to be swiveled round under the carriage when folded up, out of the way of the mud and dirt thrown from the wheels, and without turning them up inside of the carriage."

FOR A MACHINE DENOMINATED A "ROTARY CURVE," TO BE USED IN CONSTRUCTING CISTERNS. *Orlando Owen.*—The patentee says,—"The usual mode of building cisterns is, to form an inner and outer curve or mould of wood (the outer one extending only to the top of the cylindrical part of the cistern) with the space between equal to the thickness of the wall, which is formed by pouring in small stones and hydraulic cement until it reaches the top of the outer curve; it is then carried for a short distance on the top of the inner curve to narrow the opening, and the whole suffered to dry, which necessarily takes much time, as the curves exclude the air, and the cement dries very slowly; but when it is dry, the inner curve can only be removed by breaking it to pieces. The object of my invention is to avoid this inconvenience, and to save much of the time required for drying the wall; and this I effect by means of a segment curve attached to one end of an arm connected with a central standard, in such manner that it can be moved around the standard, and carried up and down, and inclined to form the top—the arm being made in two parts that slide on each other, to adapt the segment curve first to enable the operator to trim the hole in the earth to the required diameter for the outside of the cistern, and then to the inner diameter thereof. The two parts of the arm slide on each other, and can be secured at any desired point by means of a set screw, and it is connected with the central standard by means of a ferule, to which it is jointed, which ferule can be held at any desired elevation by a pin passing through holes in the standard; and for the purpose of giving the arm any desired inclination, it is mortised, and plays on a sector attached to the upper part of the ferule, and provided with holes and a pin."

FOR AN IMPROVED METHOD OF MOULDING FOR CASTINGS. *Francis N. Still.*—The patentee says,—"The nature of my invention consists in using two patterns for one casting, and having those patterns placed with the reversed sides up, and made stationary in two separate flasks, filled with plaster of Paris; my object in using two patterns, is that I may mould from concave and convex patterns, such as cannot be divided or moulded from a plate; my object in using the two flasks of plaster of Paris, is that I may get two concave and convex surfaces to fit each other perfectly, and at the same time fit the particular shape of the patterns, so that when a flask of sand is filled upon each of them, taken off and closed together, it will form a perfect mould from said patterns."

ADJOURNED INQUEST ON MR. DAKIN.
May 23.

The Jury returned the following verdict:—"Accidental Death. But the Jury cannot separate without expressing their opinion that the casting of the oven was defective; but, from the conflicting evidence of the scientific men, they are unable to decide as to the real cause of the explosion."

Railway Carriage Axle Grease.—Some mystery has been made on this subject, and patents taken out for various articles, but I believe, from experience, the following is the best:—Take 56 or 60 lbs. of soda, dissolve in about 3 gallons of water in a small boiler; when quite dissolved, to be poured into a large tub or wooden cooler, containing from 30 to 36 gallons of cold water, and well mixed. Tallow to be melted (according to the proportions hereinafter stated) in a 40-gallon boiler. After being thoroughly dissolved, palm oil is to be added, and then the mixture allowed to boil; as soon as it boils the fire to be taken out of the furnace, and the mixture to be cooled gradually, and to be frequently stirred while cooling. When cooled down to blood-heat (98°), it is to be run off through a sieve into the cooler containing the water and soda, and it must be stirred during the whole of the time it is running off, in order that it may be properly mixed.

Proportions of Oil and Tallow.

Summer Weather.		Winter Weather.	
Palm oil......	1 cwt. 1 qr.	Palm oil...	1 cwt. 3 qrs.
Tallow	1 „ 3 „	Tallow	1 „ 1 „

In open Weather (Spring or Autumn).

Palm oil............	1 cwt. 2 qrs.	equal quantities.
Tallow	1 „ 2 „	

—*Salt's Facts and Figures.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

Abraham Solomons, of London, merchant, and Bendy Assulay, of Rotherhithe, Surrey, printer, for improvements in the manufacture of gas, tar, charcoal, and certain acids. May 26; six months.

Matthew Hague, of Waterhead Mills, Lancashire, machine maker, and Joseph Firth, of Huddersfield, Yorkshire, cotton doubler, for certain improvements in machinery for twisting and doubling cotton yarns and other fibrous materials. May 26; six months.

Moses Poole, of London, gentleman, for improvements in propelling vessels. May 26; six months. (Being a communication.)

James Parker Percy, of Clarendon-place, Notting Hill, gentleman, for certain improvements in obtaining copper from copper ores. May 26; six months.

James Remington, of Warkworth, Northumberland, civil engineer, for improvements in locomotive engines, and in marine and stationary engines. May 26; six months.

Thomas Richardson, of Newcastle-upon-Tyne, chemist, for improvements in the manufacture of manure. May 26; six months.

Felix Hyacinthe Folliet Louis, of Southwark, Surrey, gentleman, for an improved method or process of preserving certain animal products. May 26; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
May 20	1453	Richard Stratton	Bristol	Water cart.
22	1454	Francis Wishaw, C.E....	Gray's Inn-square, London	Whishaw's Telekouphanon, or pneumatic telegraph.
23	1455	Thomas Powell	Birmingham........................	Blind pulley.
25	1456	Edward George Barton, and Joseph Clowes, Esq.....	Lambeth ....; Camberwell	The Universal Gas Meter.
„	1457	George Howe	Great Guildford-street, Southwark	Steam-boiler water gauge.

CONTENTS OF THIS NUMBER.

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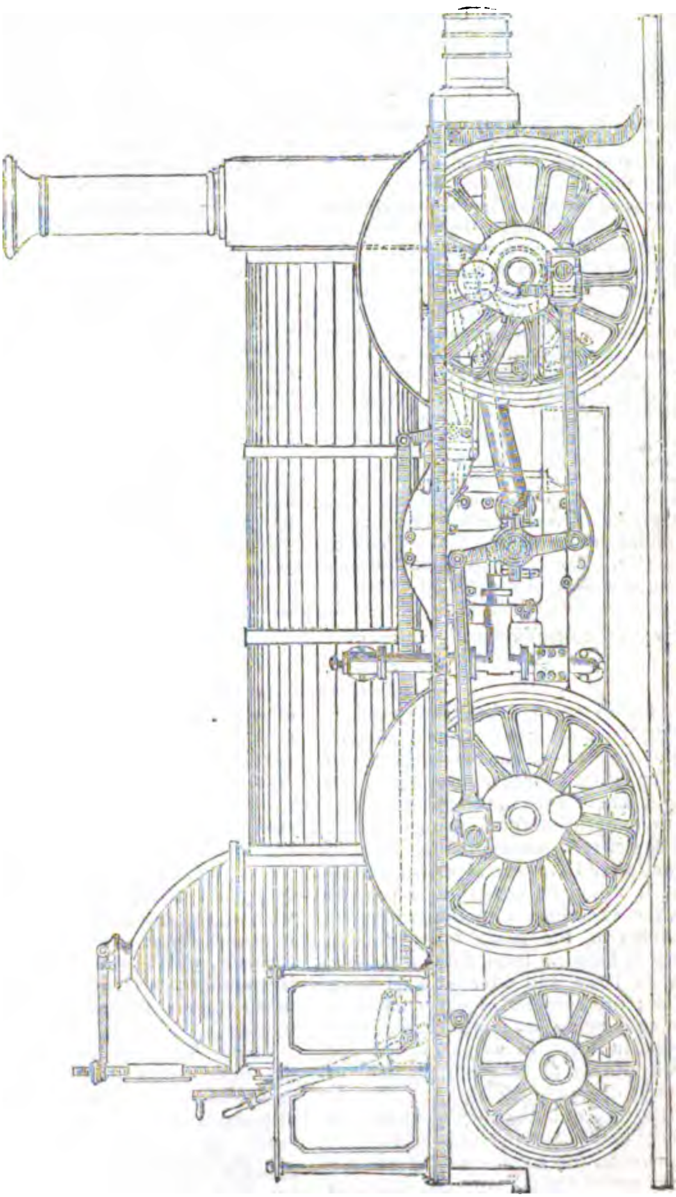
Edited by J. C. Robertson, 166, Fleet-street.



THE CAMBRIAN LOCOMOTIVE ENGINE.

THE CAMBRIAN LOCOMOTIVE ENGINE.

We quote the following notice from the *Bradford Observer* of the 18th May:

"On the afternoon of Thursday (May 11,) thousands of spectators witnessed the novel spectacle of a splendid new locomotive passing through the streets from the Albion Works of Messrs. T. Thwaites and Co., Thornton-road, to the station of the Leeds and Bradford Railway. A trial trip was made with it on Saturday afternoon. The train reached the Skipton station (eighteen miles) within ten minutes of an hour from leaving Bradford, including several short stoppages by the way. The return trip was made in about the same time, without the slightest casuality, or the exhibition of any weak points about the locomotive.

"This is the first locomotive ever made upon what is called the 'Cambrian principle.' The peculiarities of its construction consist in segmental cylinders, placed horizontally beneath and at right angles with the boiler; into which cylinders pistons are fitted, the centre parts or shafts of which work on separate bearings, between the front and centre wheels, and on the ends of these piston-shafts are placed double cranks or beams, from the opposite ends of which pass connecting-rods to the crank-pins on the leading and centre driving wheels, on each side of the engine. The pistons communicate an oscillating motion to the double cranks or beams, the lengths of which are so adjusted as to cause the driving wheels to make whole revolutions. By this arrangement the strain of the working parts is so balanced, and the pressure and resistance are so equalized, that the engine moves on with such extraordinary steadiness, that all dangerous oscillation at high velocities is completely obviated.

"The vibratory piston-shaft and double crank, the two connecting rods, one end of which moving in an arc, the other describing an entire circle, present a beautiful mechanical movement, and give to the engine a novel and pleasing appearance."

The "Cambrian principle," on which this engine has been built, was the subject of a patent granted to Mr. John Jones, 7th April, 1841, and is fully explained in the specification thereof, published in this Journal, vol. xxxvii., p. 1. We pointed out at the time its great applicability to locomotive purposes, and have often felt surprise at the delay of railway engineers in turning it to account. The great success which has attended all the stationary engines built on this plan,* induces us to anticipate with great confidence an equal share of good fortune for the Cambrian Locomotive. We give on our front page an engraving of Messrs. Thwaites and Co.'s engine.

ON NAVAL CONSTRUCTION. FROM THE UNPUBLISHED PAPERS OF THE LATE BRIG. GEN., SIR SAMUEL BENTHAM.

(Concluded from page 511.)

In regard to experiments for ascertaining the most advantageous mode of employing each of the several forces in use for giving progressive motion to vessels, whether wind, steam, or manual labour, experiments on this subject would best be deferred, until the fittest form of the hull shall have been ascertained; this done, it would be advisable to proceed with the experiments on the locomotive apparatus in the same manner as in regard to those on form, first on models, then on boats, and afterwards on large vessels; the subjects of experiment in each case being made perfectly similar in bulk, in form, in weight, and loaded likewise, so as to be made perfectly of the same degree of stability.

With respect to the most advantageous mode of employing the force of wind, in other words, the most advantageous rig for any vessel—as the progressive motion depends on the impulse of the wind on the sails, together with that impulse on every part of the vessel itself, with its appendages, which is exposed to the wind, the principal objects of the experiments are consequently, to ascertain in regard to each description of vessel,

1st. What is the quantity of surface, form, and position of the sails, as likewise of the masts, yards, booms, &c., necessary for supporting and extending the sails, which would be most advantageous for progressive motion; and that under various circumstances of wind and weather.

2ndly. What is the modification of the whole apparatus, whereby the extent and position of the sails may be varied at pleasure in the least time and by the

* The chief makers are, we believe, Messrs. H. Crosley, Son, and Galsworthy, of Emerson-street, Southwark.

fewest hands; keeping in mind that the impulse of wind, whilst it operates to give progressive motion to the vessel, acts also on some occasions, unavoidably, not only to incline the vessel transversely, but likewise in some degree to depress, or very much to raise it.

For ascertaining each of these particulars, it is essential that any modifications of the apparatus brought into comparison should in each experiment differ one from the other only in regard *to one* particular, so that there should be no doubt as to the particular to which any difference in the result is to be attributed.

These experiments, like those on form, may be made successively on models, boats, and large vessels.

As in sailing with a side wind, the vessel, by the consequent change of form of the immersed part, is liable to luff up more or less to windward, according to the variable force of the wind, this tendency in a real boat or vessel would have to be counteracted as usual by the helmsman; but, in the case of models, the rudder might be suitably directed by some mechanical contrivance; for instance, by means of a perpendicular pendulum suspended by its middle, the upper end being connected with the end of the tiller, and a weight being applied to the lower end. The effect of this apparatus, would be that the more the vessel heeled, the more that weight would move the tiller up to windward, and thereby cause the rudder to counteract the tendency to luff up.

There are many experiments, however, that could not well be tried on anything less than a boat large enough for a man to be stationed in it, who should keep the vessel at a proper angle with the wind during its variations in force and direction; and it must be observed that in this case, the smaller the boat, the greater must be the care taken that the position of the man shall not be changed so as to influence the stability of the vessel, or the extent of surface which his body may oppose to the adverse action of the wind.

In regard to experiments at sea on sailing vessels, whatever be their form, and of whatever description may be their sails, together with their masts and other appendages and apparatus, subservient to the giving progressive motion, it is evident that the result of any experiment to ascertain the comparative superiority of any part of the apparatus, would very materially depend on the arrangement of the apparatus being varied from time to time, to suit the variations as they take place in the force and direction of the wind.

Hitherto, no means seem to have been employed for ascertaining with sufficient accuracy any of those changes, either in the position of the sailing apparatus, or in the force or direction of the wind. That these changes may be ascertained with the requisite accuracy, various new instruments or apparatus will be necessary for measuring the progressive motion of the vessel, the force and direction of the wind, the direction of the sails, the angle of inclination of the vessel longitudinally as well as transversely, as also the angle to which the rudder is set for the purpose of regulating these several directions. These same instruments should also note and register the instant at which every important variation takes place, and consequently show the period during which the state of the vessel, in regard to each particular, remains without change. To effect this purpose, as independently as possible of the constant care and attention of those to whom the management of the experiments is entrusted, the several *meters* may be made to mark these changes upon tablets and that a constant and regular motion might be given to them by connecting them with a clock.

Lastly, if in experiments on vessels similar in all particulars which can be supposed to influence the result, and tried under the circumstances apparently the same, the result should nevertheless be found to be different; in this case, in order to exhibit whether, and how far, that difference had arisen from difference in the management of the experiment, or in the skill of the helmsman, it would be advisable to change from one vessel to the other the persons on whom the management and steerage depend, every thing else remaining the same.

As to the application of the force of steam, it is evident, that the quantity of force applied will depend on the quality as well as on the quantity, and on the mode of applying the fuel employed for the production of steam; on the fitness of the machinery for causing the expansive force of the steam to give the proper motion to the vessel by paddle-

wheels, or by such other apparatus as may be found most advantageous for acting against the water. The object of the experiments would therefore be, to ascertain the comparative fitness, one by one, of the different parts of the whole apparatus, which have been, or may be employed for this purpose; as, for instance, in regard to paddle-wheels, on their number and position in the vessel, as well as on their size and shape; the weight and dimensions of the whole apparatus being as little as can answer the purpose. It is true, that many of these particulars have been already in a great degree investigated, but still, further experiments are required with a view of preventing such vessels from being, as now, liable to be alternately wholly immersed in the water, or entirely out of it, or of getting rid of the smoke and of the obstruction of the chimney, by trying apparatus other than paddle-wheels. Some of these particulars are, in a great degree ascertainable readily, and at a trifling expense, by applying a strong clock spring to give motion to models of vessels in which the paddle-wheels, or other apparatus for applying the moving force; which apparatus may in each case be differently arranged.

As to the fittest mode of applying manual labour, whether to this, or indeed to any other purpose, this seems to stand more in need of scientific investigation, assisted by past experience, than of any new experiments. Mathematical calculations may determine the most advantageous position of a man in regard to the application of his force, in the case where no habitual exertion of any particular muscles has given unusual strength to any particular set of them; but when men, by their usual employments have acquired extra power in any member of the body, this circumstance would have a contrary influence. Mr. Fincham, for instance, in the mode he proposed for applying the force of men, noticed the particular advantage of its being a mode to which sailors were accustomed; but although his mode appears to be the best hitherto proposed, the force applied would not be very great unless some steadiment were afforded to the feet.*

In regard to this force, however difficult or even impracticable it might be, to ascertain the exact degree of it that might exist on board of any vessel, and however variable it might be, on account of the number, the habits, and the disposition of the crew, nevertheless, considering the very great importance in regard to vessels of war (for example) of being able to come up with, and to take any required position in respect of an enemy, and in regard to all vessels of being able to avoid any imminent danger when the force of wind is wanting or adverse, it seems highly expedient with a view to the employment, at least occasionally, of this very efficient force, to ascertain the fittest apparatus by which—at one time the force of a position, and at other times that of the whole number of the men on board any vessel—may be applied to the giving it motion. The amount of this force would in some cases be equal to that of a powerful steam engine; and on many occasions there could be no doubt of the degree of exertion as depending on good will. This same apparatus, if contrived to be the fittest for applying the force of men to giving locomotion, might be contrived to serve likewise for applying this force, more advantageously than at present, to the various purposes for which manual labour is now employed on board of all vessels, such as for raising the anchor, the sails, masts, yards, &c., and for pumping, whereby the need of the many separate, cumbersome, and expensive contrivances, such as capstan, windlass, &c., now in use, each only for one particular purpose, might be superseded.

Having ascertained the form of a vessel, with its appendages, the most advantageous, with a view to the several distinct qualities above mentioned, it would then have to be considered, for what different purposes of commerce, or of war, a vessel of that form may be rendered applicable, and in what degree the giving appropriate fitness for any of those purposes, would unavoidably diminish the above specified good qualities of the vessel.

* Sir Samuel further observed in regard to this mode that, as it was applied in walking, and that without effect through half the space the men now traversed, it would be liable to be deranged by the pitching and rolling of the ship. In a mode Sir Samuel afterwards invented, the men were to be seated, their feet steadied on the deck, and the motion of their arms the same as in rowing. A model of the apparatus for taking hold of, and letting go again, the rope, was presented to the Admiralty.

Also, what modifications of that form could be admitted of, so as to render a vessel applicable to the greatest number of purposes, as stowage of merchandise, conveyance of passengers, transport service, or war offensive and defensive.

The sailing apparatus has, perhaps, been even less systematically experimented on, than that of the form of vessels. Wind being an uncontrollable force, and acting on the parts exposed to it of the vessel itself, experiment will be requisite to ascertain what modifications of its form may be desirable on this account. An adverse wind, acting on every part of a vessel exposed to its impulse, not only tends to drive it before the wind but to incline it laterally, with a tendency to upset it; the requisite modifications of form would therefore be such as experiment should prove to afford as much resistance as possible to lateral motion, or leeway, and to inclination, weatherliness, and stability.

Weatherliness being usually obtained by depth of hull, and great depth being a quality which diminishes materially the efficiency of a vessel, whether for commerce or for war, as rendering it inaccessible to places in shallow water, experiments should be made to ascertain what apparatus, as lee-boards, &c., can best be added to a vessel, so as to afford weatherliness otherwise than by depth, and by an apparatus that may be drawn in on occasions when its projection would be disadvantageous.

As to stability, the obtainment of it by moving ballast, &c., within the vessel, as also beyond it by means of outriggers, is well known, and the amount of it is ascertainable by calculation; but experiment is wanting to ascertain the readiest means of effecting this purpose, and of extending a weight to windward, to afford additional buoyancy to a vessel on the event of a sudden discontinuance or change in the action of the wind, by which otherwise the vessel might be upset in the opposite direction. So also stability might be obtained by extending in breadth the parts usually out of water, so as to give the inclined vessel an increased buoyancy on the lee side to oppose the inclination.* Stability might be further increased by giving the vessel a double form, as if two vessels were joined side by side, so as to leave a passage for the water between their two halves for the purpose of diminishing resistance to progressive motion, whilst from the extension of them one from the other, resistance to lateral inclination would be increased.

As to the sailing apparatus, long as the time is that different sorts have been in use, and numerous as are the varieties employed, it will be found that little has been done towards ascertaining the comparative advantages of any of these varieties, in a manner to afford just grounds on which to determine which of them is the fittest for any particular purpose or service—still less to determine whether some better modification of the apparatus might not be devised. Although much experience has been had in regard to each of those varieties, although experimental vessels have been sent out, and even constructed, for the express purpose of ascertaining the merit of some modification of the sailing apparatus, as well as of the form of the vessel; yet, as perfect similarity has not been insisted on in respect of every particular which might influence the result, the effect of any particular modification could never be distinctly known, and no practical inference could therefore be drawn from any such experiments.

In instituting experiments relative to the sailing apparatus, the following points will probably be admitted as not requiring experiment.

First. That the whole of the apparatus for extending the sails, as well as every part of the vessel, should expose to the wind as little surface as possible, at any other angle than that found to be the best for progressive motion.

Second. That the angles at which the sails are placed should be, while they are the most advantageous for progressive motion, at the same time such as to tend rather to raise the vessel out of the water than to depress it.

Third. That the position of the total quantity of sail should be as low as possible, in order to prevent the wind from inclining the vessel in any direction; keeping in view, at the same time, that, in an agitated sea, the high waves may prevent the wind from acting at all, or but very irregularly, on the lower sails.

* This was exemplified in the seven vessels of Sir Samuel's construction, and it has since been adopted in the *Great Britain*, at least.

Fourth. The quantity of sail which a vessel of a given bulk, weight and form, should be enabled to set, being determined, that it should be so arranged lengthwise, as that the impulse of the wind should tend to make the vessel deviate as little as possible from the desired course, so that the least action of the rudder should be required to counteract that deviation, since that action of the rudder cannot but impede the progressive motion.*

Fifth. That the apparatus should afford the means of increasing, or diminishing the quantity of sail exposed to the wind with as much expedition as possible.

Sixth. That in regard to the whole of this apparatus, as in regard to every article requisite for navigation, the qualities of lightness, compactness, durability, facility of repairs or renewal, interconvertibility,† and cheapness, should be considered in deciding on the variety to be adopted.

The particulars to the ascertaining of which experiments are required, appear to be the following:

1. What is the total quantity of sail requisite to be extended on board a vessel of a given weight, bulk and form, and of which the degree of stability has been previously ascertained?

2. The quantity of sail being determined on, what, by the arrangement of it, is the situation which the centre of the impulse of the wind should be made to have in regard to the centre of gravity, and to the centre of resistance of the vessel?

3. What is the best angle at which the sails should be placed in relation to the direction of the wind, and to that of the middle line of the vessel while working to windward?

4. What is the fittest apparatus for extending the sails upwards, whether single masts, or compound supports, such as sheers, triangles, &c.; and what is the most suitable number and position of these supports in regard to the length and breadth of the vessel?

5. What means are the most advantageous for extending the sails horizontally, such as

[Note—Here a page of manuscript is wanting.]

9. How far bolt-ropes, and seams, inasmuch as they project beyond the flat surface of the sails, increase lee-way, by affording hold to the adverse action of the wind?*

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* A second rudder placed at the head of a vessel would afford means by which it might be made to hug to windward in a much greater degree than could be effected by the stern rudder. Such an additional rudder would also be a powerful aid on occasions where it is necessary to change suddenly the direction of the vessel.

[The above note appears in the original paper, and is followed by an allusion to this improvement as having already been introduced, doubtless in reference to a rudder placed at the head of one of Sir Samuel's experimental vessels. This fact, is not, it is true, recorded in any of the printed papers relative to them, but it was communicated by a gentleman who was present at the construction of all the seven vessels, and who was intimately acquainted with their peculiarities.]

† The principle of interconvertibility, that is, the fitness of an article to be suitable for several purposes, whereby fewer articles of spare stores need to be carried to sea, was devised by Sir Samuel, and exemplified in several parts of the sailing apparatus of his vessel, the *Arrow*. See Report of the Select Committee on Finance, 1798.

* Could a vessel be made to expose to the wind no other surface than that of sails composed of materials perfectly flat, such as a metal perfectly flat, polished, and impervious to wind, in that case, the angle to which such sails might be set might be the most acute; but sails, consisting as they do, with a view to lightness and facility, of extension and contraction, of flexible materials, cloth woven in small breadths and sewn together having bolt ropes to strengthen them at their edges, the projection not merely of the bolt ropes and seams, but even the small projection of the threads as woven together, afford impediments to the free passage of the wind over their surfaces, which impediments, independently of the difference of the angles which the different parts of the sails present, require that, in proportion to the amount of these deviations from the fittest angle, the general angle at which the sails are set, should be much greater than would otherwise be necessary, in order, that the advantageous impulse of the wind should be made more forcible, to overcome the disadvantageous action on these irregular surfaces.

(*Note by the Editor of this Paper.*)

During the Naval Adminstration of Earl St. Vincent, a ropery and sail-cloth manufactory proposed by Sir Samuel was sanctioned by an Order of Council; why it has not till this time been executed is not to the present purpose; but among Sir Samuel's notes of improvements he projected, relative to these articles of naval equipment, were experiments as to sail cloth, so as to do away the projections of seams and to diminish those of bolt ropes. The sail cloth he proposed to manufacture for trial with slighter yarn in the warp at the edges, than for the general texture of the cloth, so that the parts doubled over to make the seam, should together be scarcely more in thickness than other parts of the sail: also in lieu of round *bolt ropes*, he intended to try a kind of flat web, which might be called a bolt-tape—something analogous to the web called girthing—which, being sewed to the back of the sail, might without roughning the face of it afford greater strength than the ordinary rope. Another great advantage expected from the use of bolt-*tapes*, was that they might be made so as to contract or expand in an equal degree with the sail cloth on being wetted or dried, thus obviating the great difficulty in sailmaking, of so proportioning the tightness of the rope, that the flatness of the sail should be as little disturbed as possible on change of weather. It is evident that the thimbles would require to be of a different form for a bolt-tape from those in use for bolt ropes, but this would be easily managed.

10. How far the whole of the apparatus for the support and extension of the sails may be so shaped as not to present any surfaces to the wind at any other angle than that the most advantageous for progressive motion?

11. How far in regard to those articles which do not admit of being shaped so as not to afford adverse action to the wind, they may be covered from that adverse action by placing sails to windward of them?

When manual force is used to give motion to a vessel, the points to be ascertained are,

1st. What is the direction and mode in which a man can apply his strength for the greatest length of time, with the greatest regularity and the least fatigue and exhaustion?

One particular, and that a very important one, which seems to have been but little regarded, is the nature and position of the fulcrum against which the foot is made to act, while the hand is applied to the part of the apparatus to which the motion is immediately given. In the instance of a winch, this fulcrum is the deck on which the man stands, the position of which is as advantageous as possible, so long as the exertion is to raise the winch, and his *weight* serves as the fulcrum whilst he is depressing the winch; but were he to be steadied by a pillar, against which he might lean his back, while held to the support by a strap across his breast, he would then have an advantageous fulcrum for the exertion of his *muscular* strength during the whole revolution of the winch. In the instance of the capstan, where the men apply their force by walking, the flat of the deck being the fulcrum against which they act with their feet, whilst their hands and their shoulders are applied to giving motion to the bars, the degree of force which they can exert depends on the height of the bars above the deck, and on the resistance which the deck affords to the feet, which will also depend on the weight of the man. Were the deck smooth and slippery, the amount of the force which even a heavy man could exert, however great his muscular strength, would not exceed a few pounds; whereas if the bars were very low, and if battens were fastened on the deck in a direction radial from the centre of the capstan, a man of ordinary muscular strength might exert a force of three or four hundred pounds. It is therefore more from attention to the principles of mechanics than to experiment, that improvements under this head may be expected, having reference always to the habits of the men to be employed.

2ndly. What are the simplest and most efficient means of transferring motion obtained by the force of men to the giving progressive motion to a vessel?

The boats proposed to be employed for experiment, after the fittest form of a vessel should have been ascertained as far as practicable from models, might be made subservient to experiments of a different nature. Although a number of boats would be required, of exactly the same form and size, yet the opportunity might be taken of ascertaining the fittest and most economical mode of structure; since whilst the exterior form and bulk were made the same, and the weight also the same by means of ballast to the lighter boats, the kind of material employed for their construction, and the different modes of combining and of fastening together their parts, might be different in the several boats, so as to show the comparative expense in materials and in workmanship at which the requisite degree of strength of structure may be produced; such as different kinds of wood, timbers wrought or bent, different metals, cast or wrought; different fastenings, whether screws, nails, rivets, sewing, gluing, &c.

Experiments of all kinds should, as far as possible, go on together as more economical in management, and as practical results might be the earlier attained.

Simple Apparatus for a Course of Analytical Experiments to ascertain the fittest form of Vessels for Navigation.

[This is the heading to a sheet of sketches by Sir Samuel Bentham, which are engraved on the following page; but the explanatory description, which was no doubt attached to it, cannot be found. It is evident, however, from the figures, that it was intended to ascertain by models the effect of different lengths given to a vessel having the same forms at the ends, and then by changing the ends of the vessels for others of different forms, one by one, to ascertain the effect of different forms at the least expense for models.]

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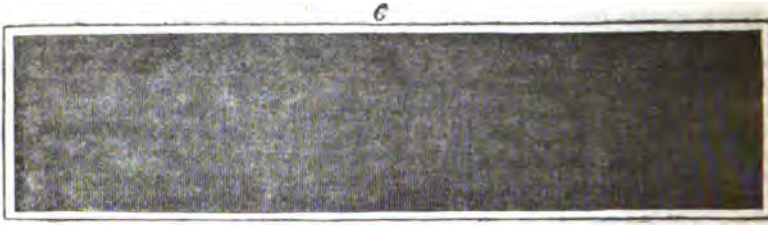

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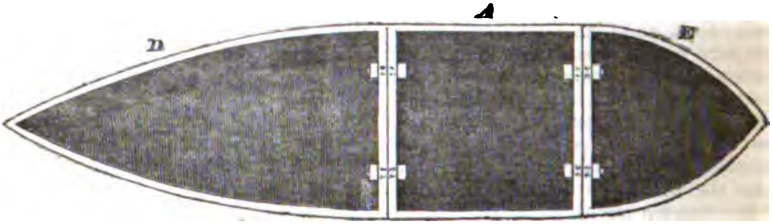

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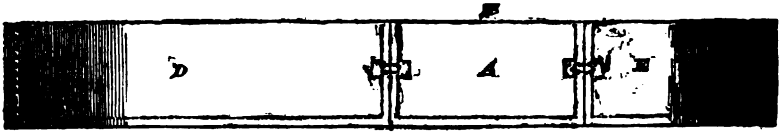

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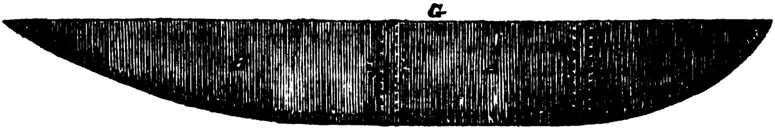

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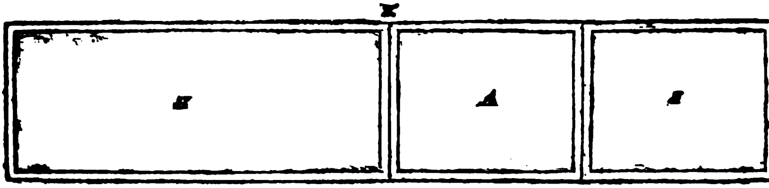

THE HISTORY OF ELECTRO-METALLURGY.

Sir,—Much misapprehension appears to exist regarding the history of electro-metallurgy, as appears by *Chambers' Information for the People*, No. 17, p. 268, and other popular publications. This subject has been so fully investigated in your esteemed journal (vol. xlv. for 1844,) that it would be quite superfluous to go into detail on this interesting matter.

All I wish now to observe is, to state briefly that we owe to Professor DANIELL, the author of the sustaining battery, the *discovery* of the principle of electro-metallurgy; to Mr. C. J. JORDAN, the author of the earliest published accounts on the subject in this country, the *invention* of the application of that principle to practical purposes, and known as the electrotype; and to Mr. Thomas SPENCER, the earliest *improvement* in the means of obtaining casts by the new process.

But this account only applies to England; it is undisputed that the earliest practical results were obtained by M. JACOBI, of St. Petersburg.

Publication of an *invention* must always be taken as settling the right to being considered a *first* inventor. Two deserving and very clever men may each have a similar invention, the fruit of independent research, without the least knowledge of each other, either personally, or as respects the pursuits of each. One may have had the notion for years, the other for only a few days; yet if the latter first exhibits his invention or prints his views, he, and he alone, can be accepted as the true inventor. He deserves of the public, what the public will always give, their approbation. The other may set up a claim, and declare that he was waiting the farther improvement of his invention, or offer any other excuse, but in vain. The press is open for all; no inventor can claim to have lost the honour of precedence in invention through his own stupid neglect to publish his discovery. He who delays may be cut off by death, and the world lose his efforts; or who knows but he may the while be bargaining whether to give to the public, or to monopolize for his individual aggrandisement? Nothing secret, vaguely talked about, or merely promised amounts to a publication; it must be made known through the medium of the press, or by public sale, or exhibition, to entitle it to originality of invention.

I am, Sir, yours, &c.,
HENRY DIRCKS.

32, Moorgate-street, London.
May 29, 1828.

NOTES ON THE THEORY OF ALGEBRAIC EQUATIONS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[Continued from page 514.]

Second Series. Note C.

I have already adverted to the impossibility of expressing the root of a biquadratic in terms of irreducible biquadratic surds. The form under which such root may be expressed is a question which has long attracted the attention of mathematicians, and in addition to the remarks which I have already* made upon the subject, I now give in a note† some observations of BEZOUT upon the form of root which EULER has assigned to biquadratics in section 6 of a paper published at pages 216—231 of the sixth volume of the Petersburgh *Commentarii*. I subjoin in another note‡ some reflec-

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* See *Mech Mag.*, vol. xlvi., pp. 123—124, 179—180, 419—423, 568—569.

† BEZOUT observes (*Mémoires de l'Académie* for 1762, p. 19,) that "M. Euler représente la racine d'une équation du quatrième degré par la somme de trois indéterminées affectées chacune du radical du même degré; et par un artifice qu'on peut voir dans son Mémoire, il parvient a réduire la recherche de ces indéterminées à une équation du troisième degré; mais les racines de cette équation sont les quarrés de celles d'une équation du troisième degré, a laquelle on parvient en représentant la racine de la proposée par la sommes des racines quarrées de trois indéterminées; en sorte que ce qui résulte de-là est qu'a la vérité on peut résoudre une équation du quatrième degré a l'aide de trois indéterminées, mais cela ne prouve encore rien pour les radicaux quatrièmes."

‡ At p. 237 of vol. xviii. of the *Transactions of the Royal Irish Academy*, Sir W. R. Hamilton says, (see the close of art. [20] of his paper on the Argument of ABEL,) that it is "impossible to discover any new expression for any one of those four roots," (*i. e.*, the roots of a biquadratic,) "which, after being cleared from all superfluous extractions of radicals, shall differ essentially, in the extractions that remain, from the expressions that have been long discovered. And the only important difference, with respect to these extractions of radicals, between any two general methods for resolving biquadratic equations, if both be free from all superfluous extractions, is, that after calculating first, in both methods, a square root"..., and a cube root... we may afterwards either calculate two *simultaneous* square roots..., as in the method of EULER, or else two *successive* square roots..., as in the method of FERRARI or DESCARTES:—for, in the view in which they are here considered, the methods of these two last mentioned mathematicians do not essentially differ from each other."

tions of Sir W. R. Hamilton upon the form under which the root of a biquadratic must of necessity appear.

Professor J. R. Young has given a new solution of a biquadratic deprived of its second term.* He starts with the consideration that, denoting the roots by x_1, x_2, x_3, x_4, the quadratic whose roots are x_3, x_4, may in such case be written as follows:

$$x^2+(x_1+x_2)x+x_3x_4=0.$$

He then, by converting the value of x deduced from this last equation into other forms, arrives (Theory of Equations, p. 456,) at the same equation as that which occurs in the solution of DESCARTES or (with but a slight difference) of EULER. This solution has its advantages (*vide Ib.*, pp. 453—454.) I may here remark that two "quadratic transformations"† of *simple* equations will be found at pp. 402—404, of Professor Young's work on Equations.

Among the general methods of the Theory of Equations must be included that given by MURPHY at pp. 161—178 of the *Philosophical Transactions* for 1837. The object of his memoir is, he states, (p. 161) "to show how the constituent parts of the roots of algebraic equations may be determined, by considering the conditions under which they vanish, and conversely to show the signification of each constituent part." He then gives certain rules to guide us in such researches. Without dwelling on them I shall merely give his discussion of quadratics and conclude by a short statement of the rest of his investigations on this subject.

For quadratics then he (p. 161) takes (x_1 and x_2 being the roots)

$$x_1=-\frac{a}{2}+\sqrt{a}$$

$$x_2=-\frac{a}{2}-\sqrt{a}$$

and hence (p. 162) finds that

$$a=\frac{1}{4}(x_1-x_2)^2$$

and the value of a is hence determinable in terms of the coefficients of the quadratic. MURPHY then extends his researches to cubics for which he takes (*Ibid*, p. 163) an expression involving two cubic radicals: and for a biquadratic (*Ib.*, pp. 168, 169,) he arrives at expressions for the roots which involve three *quadratic** radicals. He further extends his method to equations of the fifth degree (*Ib.*, pp. 172, *et seq.*,) but Sir W. R. Hamilton in a discussion of this analysis at pp. 256—259, of vol. xviii. of the *Irish Transactions* has shown (pp. 258—259) that it fails, from defect of symmetry, to furnish us with a solution of equations of the fifth degree.

I take this opportunity of observing that the symmetry of the products which occur in my Method of Symmetric Products, is noticed by Sir W. R. Hamilton, at pp. 231*′ and 233†′ of vol. xviii., and at pp. 334*′ and 337†′ of vol. xix. of the *Irish Transactions*.

With reference to a subject treated of in the last of these Notes [B]†, I would make a few additional remarks. Let there be given

$$f^m(x,y)=a \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9.)$$

$$f^n(x,y)=b \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10.)$$

where m and n are unequal. Then the solution of these two equations may be made to depend upon that of a "simple" equation of the pth degree where p is the least common multiple of m and n. For, raise both sides of (9.) to the $\frac{p}{m}$th power, and both sides of (10.) to the $\frac{p}{n}$th power, then we shall have two equations of the pth degree, which we may denote by

$$f_1^p(x,y)=a_1$$

and

$$f_2^p(x,y)=a_2;$$

we hence obtain

$$a_2f_1^p(x,y)-a_1f_2^p(x,y)=0 \quad . \quad . \quad . \quad (11.)$$

whence $\frac{x}{y}$ may be obtained by means of an equation of the pth degree, for, dividing both sides of (11.) by y^p, we obtain such an equation in $\frac{x}{y}$.

* See Young's "Theory and Solution of Algebraical Equations" (Lond. 1843) pp. 454—457. The same principle of solution may, I think, be extended to a perfect biquadratic, but of course the process will be more complicated.

† See my *Analysis*, &c., *Phil. Mag.*, current vol. (xxxii.) p. 364—365.

* Had MURPHY assumed an expression involving three irreducible biquadratic surds he could not have generalized his researches.

*′ In the case of cubics.

†′ In the case of biquadratics.

† See *Mech. Mag.*, vol. xlviii., pp. 511—512. The reader will be pleased to make the following corrections in Note B. *Supra*. P. 511, col. 2, *add* a *to the end of line* 8; and at line 18 *for* ‡ *read* *. P. 512, col. 1, last line, *for* a_2 *read* a_1; col. 2, line 22, *dele* the last); line 8 from the bottom, *dele the word* next. P. 513, col. 1, note * *for b read* b.

So, the solution of the equations

$$f^l(x, y, z)=a$$
$$f^m(x, y, z)=b$$
$$f^n(x, y, z)=c$$

may be made to depend upon that of a "simple" equation of the degree p^3, where p is the least common multiple of l, m, and n. For, having put these last three equations respectively under the forms

$$f^p_1(x, y, z)=a_1$$
$$f^p_2(x, y, z)=a_2$$
$$f^p_3(x, y, z)=a_3$$

we obtain by cross multiplication

$$a_2 f^p_1(x, y, z)-a_1 f^p_2(x, y, z)=0 \ldots (12.)$$
$$a_3 f^p_1(x, y, z)-a_1 f^p_3(x, y, z)=0 \ldots (13.)$$

divide these last two homogeneous equations by z^p, and we have two equations of the pth degree between $\dfrac{x}{z}$ and $\dfrac{y}{z}$; and these two quantities could be completely determined were we able to solve an equation of the degree p^2—the degree of the equation which results from the elimination of one of the unknowns between (12.) and (13.)

Our operations in cases of the above description will be rendered somewhat more convenient by a species of *transformation*; viz., by making

$$\frac{x}{y}=u, \quad \frac{x}{z}=v, \quad \frac{y}{z}=w;$$

a substitution suggested by the ordinary method of resolving the equations (9.) and (10.) in the case when

$$m=n=2.$$

In the remaining portion of this paper I shall omit the brackets and the included quantities which have hitherto been made to follow f^m, &c., and shall leave the number of quantities included in such function to be inferred from the remarks which precede the use of the symbol just alluded to; I shall also pass over the subject of *elimination*, further than as it enters necessarily into that of the *solution* of simultaneous equations of the higher orders. And, as it is the question of complete solution, and not of elimination, which forms the gist of what follows, I shall not notice the cases in which the solution of two or more equations of the higher orders is accompanied by that of one or more linear equations. The only effect of these linear equations is to introduce a number of linear eliminations, and their consideration would only serve to encumber our classification without introducing any real generalization.

Let us now proceed to classify, with reference to their solutions, the subject of quadratics of the higher orders—adding in brackets the process to be pursued in treating each class:

I. The solution, by means of quadratics only, of two simultaneous quadratics of the second order, and of the form

$$f^2=a.$$

[The process to be pursued in this case is given in the books, and also in the last of these notes, (B,) *ante* p. 511.]

II. The solution of two simultaneous general quadratics of the second order. [Elimination, and solution of the resulting biquadratic.]

III. The solution, by means of quadratics only, of two simultaneous general quadratics of the third order. [The method of vanishing groups.]

IV. The solution, by means of quadratics only, of two simultaneous general quadratics of the fourth order. [Combination of linear elimination with the process used in the solution of class I., *vide supra*, p. 512.]

V. The solution, by means of quadratics only, of two simultaneous general quadratics of the fifth order. [Mr. Jerrard's method (of vanishing coefficients).*]

VI. The solution of three simultaneous general quadratics of the fifth order. [The method of vanishing groups:—Group one of the given equations and eliminate; the remaining two equations will then become two simultaneous general quadratics of the second order, which may be solved by means of a biquadratic and a quadratic.]

VII. The solution of three simultaneous quadratics of the third order, and of the form

$$f^3=a.$$

[Extension of the process used in solving class I., *vide supra*, p. 512.]

VIII. The solution of three simultaneous general quadratics of the sixth order. [Combination of linear elimination with

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* I suggested this nomenclature at p. 307 of vol. xlvii. of the *Mechanics' Magazine*.

the process employed in the solution of class VII., *Ibid.*]

I hope on another occasion to offer some remarks on the *simultaneous transformation* of equations of the higher orders,—to notice solvible forms, &c. So far as the subject of *elimination* is concerned, I would remark that it is not a little singular that the elevation of degree to which it gives rise should have escaped one who has done so much for the Theory of Equations as TSCHIRNHAUSEN. That it did escape him appears clear from the quotation given below.*

TSCHIRNHAUSEN has effected the solution of a cubic by a general method. He solves a cubic in y deprived of its second term by transforming it into another in which the two middle terms are wanting.† To find y he *solves the equation which connects y and z** and which is a quadratic with respect to y. After a remark† on the root thus obtained he proceeds to make the assumption‡

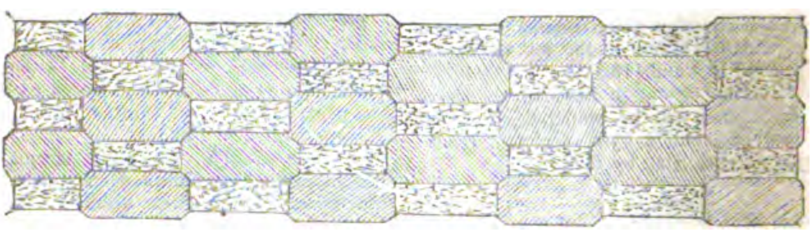
$$yz = z^2 + a,$$

and hence obtains the root in a form "quœ apprime respondet Cardanicæ expressioni."§ I may add that Mr. Jerrard was the first to pass the limits within which the process of TSCHIRNHAUSEN is confined.

In concluding I shall refer to some remarks on nomenclature which I made at p. 582 of vol. xlv. of this work. [With reference to a note appended to the paper here cited, I may add that not only at pp. 41, *et seq.*, (see also at pp. 32—33) of the *Mémoires* for 1762, has BEZOUT discussed expressions consisting of the sums of three radicals, but that his views extend to the case of expressions involving less or more than three radicals.

The Rock, Stamford, May 26, 1848.

IMPROVED COMPOUND PAVEMENT.



Sir,—The desirableness of a noiseless pavement is nowhere more observable than in the crowded thoroughfares of the city; and it is much to be regretted that the slippery character of the wood pavement has brought it into general disrepute. I have long had in mind an improvement, by combining stone with wood, in such a manner as at once to afford a safe footing for horses, with all the advantages of being perfectly noiseless. My plan will at once be easily understood by reference to the above figure, in which it will be seen that the octagonal form of the wooden blocks precludes all contact between the adjoining oblong square granite blocks, and must thereby most effectually prevent any ringing sound. This might not be so certainly ensured by substituting wood in place of the stone, and stone in place of the wood, in the proposed arrangement; however, even then, the deadening effect of the wooden blocks would be very sensibly experienced. The first construction uses more wood than stone,

* "Cum enim data equatio semper ope assumptæ ad aliam redigatur, quæ æque altas dimensiones obtinet (veluti unico intuitu patet hic fieri) in hac tertia, tres, quatuor, quinque &c. termini poterunt æquales poni nihilo, atque hinc totidem semper æquationes habebimus quot indeterminatæ adsunt, ut proinde hæ semper ope harum æquationum possint determinari." TSCHIRNHAUSEN, *Acta Eruditorum* (Lipsiæ) for 1683, pp. 205—206.

† *Acta* for 1683, pp. 206—207.

* A process that would not now be employed. See *Phil. Mag.*, current xxxii., vol., p.359.

† "quæ Radix diversa* est expressione Cardanica, et precipue quoque in eo, quod unicum signum radicale Cubicum includat; cum Cardanica expressio duo involvat." *Acta* for 1683, p. 207.

‡ Ibid. p. 207. § Ibid. p. 207.

* The diversity is however in form merely. There is no *essential* difference.

the latter plan just the reverse; and it is perhaps as well to employ only so much wood as to deaden sound.

Wood and stone in combination appear to wear well together, as may be observed by examining the wood and stone pavements, where these join at the cross streets leading from any main road paved with wood.

I consider that a road made with the compound pavement might be quite smooth on the surface, as there would always be sufficient stone exposed to afford horses a sure footing. The stone would also greatly aid the durability of the wood. This plan seems to be well worth a trial, presenting as it does all the advantages of wood pavement without its many inconveniences.

I am, Sir, yours, &c.,
HENRY D——.

London, April 14, 1848.

IMPROVED HYDRAULIC VALVE.

Sir,—I enclose sketches and description of a valve, which, if you approve of it, I shall feel obliged by your inserting in the Magazine.

I am, Sir, yours, &c.,
JOHN POOLE, JUN.

Hayle, May 18, 1848.

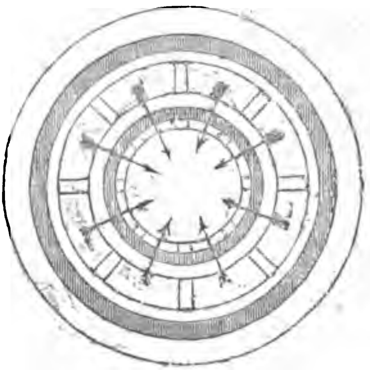
Description.

This valve, proposed for hydraulic purposes, is a modification of the bucket valve, with this difference, that the bottom beat is increased to a sufficient area for a water way, and thus considerably lessens the lift of the valve and ensures a steady action. It will be found to shut without rebounding, and consequently prevents the loss of water, the shock, and the wear and tear, which are found to attend most of the valves now at work from having too much area exposed to the action of the water. The valves again being too light in proportion to their area do not shut until the pole returns some inches. These disadvantages will, I have no doubt, be avoided by the application of the improved valve represented in the figures.

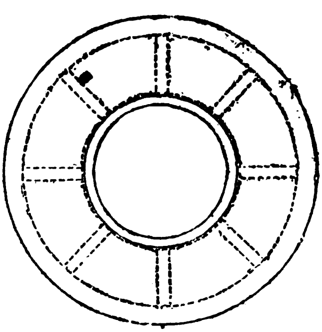
JOHN POOLE, JUN.

Copper House Foundry, Hayle, Cornwall.

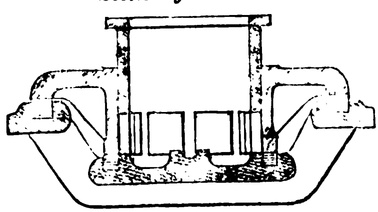
Plan of Seating.



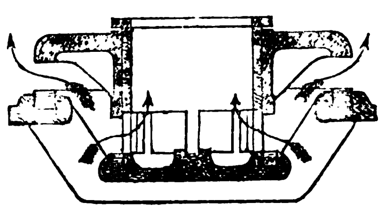
Plan of Valve.



Section of Valve shut.



Section of Valve open.



[The opinion expressed on this subject in our review of Sir John Rennie's Account of the Plymouth Breakwater, has brought us several more letters, in addition to that of "W.," inserted two weeks ago — some supporting the view taken by the reviewer, and others that of the Dover Harbour Commissioners; but it seems to us that it will be only fair to the Commissioners, before giving a place to any further comments on their Report, to lay that Report itself, *in extenso*, before our readers. We shall follow it up in our next, by some remarks of our own, and also with one or other of the communications which we have received. —Ed. M. M.]

REPORT.

TO THE SECRETARY OF THE TREASURY.

Sir,—In compliance with the directions of the Lords Commissioners of the Treasury, signified to us in Mr. Trevelyan's letter of the 30th of September last, we have the honour to submit to their Lordships the result of our deliberations on the reports and plans of the eight engineers, for a harbour in Dover Bay, which have been laid before us.

The material points for consideration appear to us to fall under the following heads:—

1st. The Area of the proposed Harbour.
2nd. The Outline or Form.
3rd. The Position and Width of Entrances.
4th. The Mode of Construction, and Materials.

Area.

The engineers, with only one exception, recommend a larger area than was proposed by the Commission of last year.

We are of opinion that the area suggested by that Commission, namely, about 520 acres, is the minimum space that will answer the object Her Majesty's Government have in view, of affording a Harbour of Refuge in Dover Bay.

Outline or Form.

We propose that the outline or form of the harbour should not materially differ from that recommended in our Report of 1844, and that the south face of the breakwater should stand as nearly as possible in the direction of the stream of tide, in a depth of seven fathoms at low water. Also, that the eastern and western arms should be carried out nearly at right angles from the shore.

Position and Width of Entrances.

The question of entrances involves the important subject of the evils likely to arise from the travelling of shingle or the deposit of silt. Having maturely considered the subject in all its bearings, we are of opinion that, however desirable in a nautical point of view, no openings should be left in either the eastern or western arm of the proposed breakwater, but that the entrances, two in number, should be placed near each end of its southern face.

We are fully aware of the prevalent belief that shingle is one of the great objections to making a harbour in Dover Bay, and this belief has been fostered by the futile attempts hitherto made to stop its entrance into the present inner harbour; but the result of the inquiry we have made on this subject is, that such a belief is not well founded; and the majority of engineers agree in saying that the movement of shingle along the shore may be arrested where required.

We think it unnecessary to say more on this subject than to refer to the evidence of the several eminent engineers in the Appendix, and to express our decided opinion that no apprehension of inconvenience from shingle ought to be regarded as an objection to proceeding with the proposed harbour in Dover Bay.

The question of silt presents a much more formidable obstacle, and, although less apparent, it is the chief difficulty to contend with in planning a harbour in Dover Bay.

Since making our last report, and in consequence of the recommendation it contained, the Lords Commissioners of the Admiralty have directed a series of experiments to be made on the quantity of silt held in suspension by the water in Dover Bay. These observations have been carried on at intervals during several months, from the beginning of February to the end of September; and we refer to the tables in the Appendix, and to the reports of the officer directed to carry out the observations.

Few harbours escape the evil of a sedimentary deposit, and if liability to silt were to be deemed an objection to the construction of an artificial harbour, it would be idle to attempt such a work on any part of the coasts of the kingdom. It is not, therefore, our purpose to contend for what is, in truth, practically impossible, as it is manifest that the greater part of whatever sedimentary matter may be held in suspension in the water flowing into a harbour, will fall to the bottom with more or less rapidity, in pro-

portion to the stillness of the water within, and only such portion of the lighter matter, as from its less specific gravity may remain in suspension, will be carried out by the ebbing tide.

We have, therefore, given our most serious consideration to the best means of meeting this acknowledged difficulty.

The two most obvious modes are—

1st. By permitting a free tidal current through the harbour.

2ndly. By admitting only the quantity of water required to maintain the level, without inducing any sensible current into the harbour.

To accomplish the first object, it has been proposed to have either a large opening at each end, or several smaller ones in the eastern or western arms of the breakwater.

All the eminent persons whom we have consulted, agree that a tidal current could not be maintained by means of a series of small openings; and to the larger openings there is the obvious objection, that they would leave the anchorage exposed in the quarter where shelter is most required—to the most prevalent wind and the heaviest sea; in fact, little better than a roadstead.

We are compelled, then, to examine the second mode of accomplishing the object, and here we have the great advantage of being enabled to refer at once to an example which has hitherto proved successful.

The artificial harbour of Kingstown, in Dublin Bay, erected about twenty years since, is enclosed by arms, running out nearly at right angles from the shore, with only a single entrance in seaward face, which lies in the fair stream of the tide.

In its immediate neighbourhood are the numerous well-known sand-banks that encumber the estuary of the Liffey. Yet, after the experience of twenty years, Kingstown Harbour remains free from any permanent deposit; and the resident engineer, who has watched it for eight years, gives it as his opinion that it owes its freedom from silt to the happy position of its entrance exactly in the fair stream of the tides.

We are therefore of opinion that the same principle should be adopted at Dover, that no opening should be left in either the eastern or western arm of the proposed breakwater, and that both the travelling of shingle and the liability to deposit from silt, point out that the only entrances should be placed in its southern face, in the fair set of the tidal stream. Also, that these openings should be large enough to fill the harbour, without causing any sensible current into it, so that the only water which will enter will be the quantity required to maintain the level on a flowing tide. Two openings, of the width of about 700 feet each, will suffice for this purpose; they will also be large enough to enable any vessel to work in or out.

The tendency to deposit from diffusion, arising from the more highly charged water outside the breakwater pressing to restore the equilibrium with the lighter water within, must not be overlooked, although we are of opinion that it will not amount to anything of importance; and after having taken all the points of this question into consideration, we are satisfied that liability to silt ought not to be regarded as an objection to proceeding with the proposed harbour, provided it have the entrances in the south face, as we have recommended. We are of opinion, also, that the stream of the Dour should be excluded from the harbour.

Mode of Construction, and Materials.

The engineers whose plans are before us, hold contrary opinions upon these important points, and when such men differ as to the best mode of constructing a work to resist the force of the waves, we need scarcely say how deeply we feel the responsibility under which we have to fulfil the directions of the Lords of the Treasury, "to report which of the plans in question we think ought to be preferred."

It will simplify this part of our Report if we give a brief summary of the several proposals of the engineers, and at the same time place in their lordship's hands the plans and observations by which each of them supports his proposition.

We shall also make a similar reference to the opinions of those persons from whom we have sought information on a subject of such vast public importance, and on which the consideration and advice of men of distinguished science, as well as of practical observation, are so much needed.

The opinions of the engineers who have submitted plans are as follows:

Mr. Walker, C.E., proposes the construction of a nearly upright wall from the bottom, to be built in caissons at Portland, and floated to Dover.

Mr. Rendel, C.E., prefers an upright wall, on principle, and, from the want of suitable materials on the spot, and the difficulty of bringing them from a distance, which he considers practically impossible, recommends the use of masses of hard brick laid in cement as a substitute.

Lt.-Col. Harry Jones, R.E., is, on principle, in favour of an upright wall; but, in his plan proposes, from motives of economy, a sloping breakwater composed of rough blocks of chalk nearly to low-water mark, on which he would raise an upright wall of stone. In a subsequent letter, he proposes the use of concrete in blocks, in courses

from the bottom, in the form of an upright wall.

Captain Denison, R.E., is for an upright wall to be built with large blocks of concrete, up to within three feet of low water, and granite for the superstructure. He prefers concrete, because he considers its cost would be much less than that of brick.

Mr. Vignoles, C.E., proposes to drop blocks of concrete, forming a slope of 45 degrees, up to three feet below low water, upon which he would raise a vertical wall.

Mr. George Rennie, C.E., recommends a sloping stone breakwater, similar to that at Plymouth.

Sir John Rennie, C.E., proposes also the same construction as at Plymouth, by means of stone, to be procured at Portland and the Channel Islands.

Mr. Cubitt, C.E., proposes in his plan a long sloping breakwater of stone from Portland or the Channel Islands; but, in his evidence before the commissioners of 1844, he recommends an upright wall to be built in caissons.

We now proceed to state the opinions of the following persons before alluded to, namely,

Professor Airy, F.R.S., Astronomer Royal.

Professor Barlow, F.R.S.

Major-General Sir J. Burgoyne, Inspector-General of Fortifications, and late Chairman of the Board of Works in Ireland.

Sir Henry de la Beche, F.R.S., Director of the Geological Survey.

Mr. Hartley, C.E., in charge of the Liverpool Docks.

Major-General Pasley, R.E., F.R.S., Inspector-General of Railways.

Captain Vetch, R.E., and C.E., F.R.S.; all of whom, either from theory or from practical observation, are in favour of a nearly upright wall.

M. Reibell, the eminent engineer, Director of the works at Cherbourg, supports the principle of an upright wall.

Mr. Brunel, C.E., has given his opinion in favour of an upright wall.

Mr. Bremner, C.E., who has conducted extensive maritime works on the coast of Scotland, is also for an upright wall.

Mr. Alan Stephenson, C.E., F.R.S., of Edinburgh, recommends a long slope.

Their Lordships will perceive that these opinions, with one exception, are all in favour of an upright wall, and it is a matter of great satisfaction to us to find that our opinions are in concurrence with those of persons from whom we could not have differed without great mistrust in our own judgment.

It is objected to a wall that it is an experiment; and no doubt it is so far an experiment that no similar work of the magnitude proposed has even been undertaken.

But breakwaters made by dropping blocks of stone into the sea and forming a long slope were also experiments, and experiments, too, which in numerous cases now serve as warnings to those who may have to decide upon the construction of such works.

We know not of any instance in which the long slope has been adopted without encountering in the progress of the work the most destructive shocks from the waves—witness Cherbourg and Plymouth.

At the former, after the work, during a space of forty years, had been three times raised above high water, and the upper portion as often beaten down by the sea—after every effort that skill or experience could suggest to give it stability, this mode of construction above low water was abandoned, and an upright wall was adopted as the only alternative. At the latter place, the disasters to the breakwater are so well known as to need no notice here.

At both the above-mentioned places the breakwaters stand in deep bays; but on referring to the chart of Dover, it will be seen how slightly that bay is indented, and that a work there constructed with a long slope by dropping masses of stone into the sea will amount to the formation of an artificial reef of rocks, and occasion a bed of breakers extending into the fair-way of the Channel.

One of the engineers calculates the quantity of stone necessary to form a breakwater, with a long slope, at seven millions of tons.

A communication recently made to us by the Lords Commissioners of the Admiralty, exhibits an instructive catalogue of the present state of the harbours on the coast of Ireland constructed with a long slope.

At Kingstown the foreshore of the eastern pier has required constant and heavy repairs, and is still insecure.

Ardglass Pier, built in 1829, of large rubble stone, with a long slope, now lies, together with its lighthouse, a mass of ruins in the sea.

Donaghadee Pier, constructed in 1820, of rubble stone, with a long sea slope, has had its glacis torn up by the south-easterly gales, and a part of the materials carried half across the harbour's mouth.

Portrush Pier, constructed in 1826 of large rubble stone, with a long slope, was found to be so much damaged in 1844 that the engineer called upon to examine it reported that 4,000 tons of material had been washed from the outer extremity of the slope round the pier head, and had formed an artificial reef 70 feet in length, rising 3 feet above low water.

At Dunmore, the pier was built in 1815 of large rubble stone, with an average slope of 3 to 1. In 1832, the works were in so ruinous a state that the engineer reported that the sea pavement had been broken up and the pier breached through almost its whole length, and that the breaches were widening and advancing towards the pier head every storm.

When examined in 1845, it was found that many large stones had been previously washed from the slope, and then formed a spit from the pier head 112 feet long, projecting in a slanting direction across the harbour's mouth, and dry at low water.

In contrast to the above facts, we quote from the same official communication relative to Kilrush Pier, which fronts the Atlantic, near the mouth of the Shannon:—

"When examined in September last it appeared in perfect order, nor has it cost one shilling for repairs since it was completed. Kilrush Pier presents an upright wall to the sea."

These practical illustrations, together with the weight of evidence bearing on the subject, lead us to an unhesitating recommendation of a wall nearly upright to form the enclosure of the harbour proposed to be constructed in Dover Bay.

With respect to the description of material to be employed, we have had to consider the very serious difficulties arising out of the want of stone of a suitable quality in the neighbourhood of Dover. If granite could be procured of the required dimensions in sufficient quantity, and with ordinary facility, it would undoubtedly be the proper material to use.

Portland and the Channel Islands have been pointed out as the places from whence supplies of stone may be obtained; but both are at considerable distances from Dover; and the delay that might occur in the supply will be obvious. Several of the engineers have in consequence recommended concrete in blocks, or masses of hard brick in cement, as substitutes for stone; the former on the supposition of its cheapness.

We think, however, there is not sufficient experience of the use of concrete to warrant its adoption for the faces of works to be constructed in the sea.

We are of opinion that, if stone cannot be readily procured, masses of brick of a proper quality, laid in cement, may be used for all purposes below low-water mark, with perfect confidence in the strength and durability of this material; but that above water, granite or hard stone will be necessary.

We do not enter into any detailed specification of the plan and dimensions of the piers, which will be the duty of the engineer who may be employed. Their breadth will have to be determined by the space required for quays, coaling stations, and for general mercantile convenience. We consider that the interior or hearting may be composed of rubble and concrete; and we would strongly recommend that the work be commenced at as many points as practicable, at the same time.

It will be seen, from the opinions we have stated, that we cannot give our unqualified approval to any one of the plans submitted to us. But in obedience to their Lordships' instructions, which direct us to name which of the plans we prefer, we have to state our opinion that, in the several points of general form, entrances, construction, and material, we give the preference to that of Mr. Rendel, with the alteration, however, of the eastern and western piers which we have proposed.

We should, however, be greatly wanting in justice if we did not here bear testimony to the talent displayed in the rest of the plans and reports which have been laid before this Commission, and if we did not acknowledge the cheerfulness with which their authors afford the most detailed explanations, and submitted to the most minute examination.

For further explanation of various points, only briefly touched upon in this report, we refer to the evidence, and especially to the opinions, of the eminent engineers and other scientific men whom we have examined; and to the several documents contained in the Appendix.

We cannot close this Report without again urging on their Lordships' consideration the necessity of commencing as soon as possible the preliminary works for a Harbour of Refuge at Dover; and in the concluding words of our last Report, we venture to express our earnest hope that no pecuniary considerations will be allowed to delay the accomplishment of an object of such vast importance to the welfare of our shipping, and to the general interest of the country.

We are, Sir,

Your most obedient Servants,

T. Byam Martin, *Admiral.*
J. Henry Pelley, *Deputy Master of Trinity House.*
F. Beaufort, *Hydrographer to the Admiralty.*
J. Washington, *Captain, R.N.*
J. N. Colquhoun, *Lieut.Col., R.A.*
R. C. Alderson, *Lieut.-Col., R.E.*
H. R. Brandreth, R.E., *Director of Admiralty Works.*

Note.—Sir Howard Douglas and Sir W. Symons decline to sign the Report.

Rear-Admiral Deans Dundas has been absent from England during the sitting of the Commission.

Gwydyr House, Whitehall, January 28, 1846.

MESSRS. MORGAN AND BARBER'S AURORAL OBSERVATIONS.*

The month of October, 1847, was a memorable one in meteorological annals for displays of the aurora borealis, such as had not been often before, if ever equalled, for splendour and beauty. Nowhere were these displays more conspicuous — nowhere, at least, were they better observed than at Cambridge and the Gogmagog Hills in its immediate vicinity. By common consent, the task of recording, by pen and pencil, the observations made on the occasion, was intrusted to two young academicians distinguished beyond most of their fellows for their devotion to astronomical pursuits—Mr. John H. Morgan, of Jesus; and Mr. John T. Barber, of Trinity. A subscription was entered into for defraying the necessary expenses; and the general result is, the work now before us—a work which is in every way worthy both of the occasion and of the academic auspices under which it appears.

Ten out of twelve of the plates which form the staple of the book, exhibit coloured representations of the aurora of Oct. 24, 1847, as seen in its various phases from the Gogmagog Hills.

"We were stationed during the greater portion of the time upon a range of hills, generally known in Cambridgeshire as the 'Gogmagog;' from the summit of these, we had a boundless view of the whole heavens, at a distance of four or five miles from the light and smoke of the town of Cambridge, without a single interruption; we systematically observed the marvellous changes, one agreeing to regard more particularly one portion of the heavens, while the other confined his attention to the remaining part; thus we can certainly assert our view to have been as favourable to the giving a perfect record as the rapid changes would permit."

The engravings are exceedingly beautiful; and the authors might have said with truth of all of them as they do of one—"happily our artist, has succeeded very well with this sketch, for indeed *no description* can convey a fair idea of its beauty." At the same time, they may claim for their descriptions—inferior as they perhaps necessarily are to the pictorial representations—the merit of presenting as vivid a picture of auroral phenomena as any on record. We quote a specimen:

"It was about 11 h. 35 m. when the aurora presented the appearance shown in Plate VII.; until this time the beams had principally proceeded from an altitude varying between 10° and 23° above the horizon, being so arranged that their lower portions formed an arc whose vertex was about 22° W. of N.; and therefore the whole segment appeared to be bisected by the plane of the magnetic meridian: it had been observed for some time that this apparent arc, as we may call it, was gradually rising to a higher altitude above the horizon, when, at 11 h. 25 m., after attaining a height of 38°, it seemed to vanish, and the aurora was like a band of successive parallel beams of light hanging from the sky, the lower tips of the rays being intensely white in colour, and very much resembling the light of the moon reflected from silver; the eastern part appeared like a curtain, whilst an undulating motion, propagated through its whole extent in a direction perpendicular to that of the beams, reminded you of the folds of a ribbon gently agitated by the wind; the breadth of this band might be somewhere about 16°, and it extended from W.S.W. to E.N.E.; at one time a second curtain of light seemed to fall from the sky, and over the former one, but not reaching so far towards the horizon by 5°. All these rays continued rising higher till nearly 11 h. 38 m., when they darted out in two opposite directions, one towards the horizon, and the other to the magnetic zenith, forming the most beautiful exhibition of aurora that can possibly be conceived, and considering the latitude, such a one that we may never expect to see again;* for the second† time during the evening a crown was formed near the magnetic zenith, from which all the rays appeared to diverge; their colours were most splendid and of peculiar transparency, especially the red and green; the former being quite like carmine, the latter that of the pale emerald; the central part of this canopy, or that near the magnetic north, was of a very yellow colour, one streamer being quite like gold; the definition of the

* "An Account of the Aurora Borealis seen near Cambridge, Oct. 24, 1847; together with those of Sept. 21, 1846, and March 19, 1847, seen at the Cambridge Observatory." By John H. Morgan, of Jesus College, and late of the Cambridge Observatory, and John T. Barber, of Trinity College, Cambridge. With Twelve Coloured Engravings.

* Plate VIII.

† The first one appeared between 7 h. 7 m. and 9 h. 15 m. nearly.

outline against the sky was most perfect, and very remarkable, the brilliancy being so great, that notwithstanding the full moon, the reflection of the auroral rays was easily perceived from pools of water in the road. It was not long before this magnificent dome of light reached its maximum brilliancy, which took place nearly at 11 h. 46 m., and in this state it remained till about 12 h. 0 m., the sky having all this time the appearance of a 'cupola on fire;' indeed, no description can give any idea whatever of the phenomenon between the two latter times, to those persons who were so unfortunate as not to witness it. Between 11 h. 43 m. and 11 h. 50 m. not the least conspicuous part of this meteor consisted in an enormous sheet of white flame, undulating in a most striking manner, at one time being visible, and the next moment having vanished, appearing to oscillate backwards and forwards from E. to W., and being obscured when it passed behind the scarlet ray in the E.; its breadth was 8° at an altitude of 12°, in form it resembled a pyramid whose vertex was at the centre of the diverging rays. The best illustration of these palpitating motions is that of a large volume of flames rolling in a reverberatory furnace, and indeed at 9 h. 0 m. the sky presented very much the same appearance. At the time of the formation of the dome of light, $\beta, \gamma, \delta, \zeta, \delta$, Ursæ Majoris and α Can: Ven: were frequently rendered invisible on account of the great brilliancy of the phenomenon."

The two remaining plates represent the auroræ which were seen at the Cambridge Observatory Sept. 21, 1846, and March 19, 1847; and are very fitting accompaniments to the present work. The authors have also incorporated, with great propriety, the independent observations made on the aurora of Oct. 24, 1847, by Professors Phillips, (of York,) Challis, (of Cambridge,) and Chevallier, (of Durham,) and published at the time in the *Athenæum*.

A striking circumstance connected with these phenomena, and one which has not as yet been sufficiently cleared up, is the contemporaneous disturbance which take place in the magnetic needle. So constant is this coincidence, that one may always take the appearance of any considerable agitation in the needle, as a sure signal to look out for streamers. Thus, for the two days preceding the 24th October, the needle was in a state of incessant oscillation; between October 23rd, 11 h. 0 m., and October 24th, 1 h. 0 m. A.M., the changes of position were very large and very frequent; at times, the magnet moved across the field so rapidly, that a difficulty was experienced in following it; and at 10 h. 6 m., October 24th, the horizontal force magnet at the Magnetic Observatory, Greenwich, was in a position (22·0 division of the scale) such as it had never been since, the commencement of that establishment. We extract these facts from an interesting paper communicated to Messrs. Morgan and Barber by Mr. Glaisher, of the Observatory, and appended to the present work.

One of two things is, in the opinion of Messrs. Morgan and Barber, the cause of these disturbances of the needle:

"Either that the electricity giving rise to the aurora directly affects the magnet, or that the intensity of the earth's magnet is constantly varying during its visibility. M. Arago remarks, that the needle at Paris has been disturbed by an aurora *below* the horizon, but whose existence is known from the observations of the polar navigators. This raises a presumption in favour of the latter hypothesis."

Messrs. Morgan and Barber note, as worthy of remark, that "the generality of the phenomena of which mention is made in this little book, took place after very heavy falls of rain and great depression of the barometer; *i. e.*, when the atmospheric electricity was most active; but that, soon before the meteor appeared, the mercury rapidly ascended."

The work concludes with a chapter of hints on the methods of observing the aurora borealis, which might, we think, have been enlarged with advantage. As it is, however, it is well deserving the attention of all future observers.

THE HOLYHEAD STEAM MAIL PACKETS "BANSHEE" AND "ST. COLUMBA."

The *Banshee* and *St. Columba* stand in more remarkable relationship than any other two steam vessels which have been recently built. Both are much of a size, both designed for the same service, and the great object aimed at in both was speed; the degree of speed too reached in both is much above the average —in one of them greater than has been ever before realised, either in this country

or, we believe, anywhere else. But the *Banshee* has been built from the designs of a government officer, Mr. O. Lang, jun., of Chatham Dockyard; and the *St. Columba* from the lines of a private builder, Mr. John Laird, of Birkenhead—each gentleman at the top, or not far from it, of the class to which he belongs. The former, again, is of the old-fashioned material, wood; the latter, of the iron-age material to which we belong—iron. The engines, moreover, of the *Banshee* are of Thames, those of the *St. Columba* of Mersey workmanship;—Messrs. Penn and Co. were the makers in the one case, and Messrs. Forrester and Co. in the other. The result of the trials hitherto made of the two vessels is altogether in favour of dockyard science, wooden walls, and Thames engineering. In what proportion each circumstance may have contributed to this result, or whether it may not have been owing to some one or two of them exclusively, are points still open to speculative inquiry; and to enable our readers to come to a right conclusion upon them, we subjoin an authentic statement of the comparative data most essential for the purpose. Some items in the comparison are wanting, which we hope to be able at a future period to supply:

	Banshee.	St. Columba.
	ft. in.	ft. in.
Length between the perpendiculars	189 0	198 6½
From figure-head to taffrail	209 0	218 0
Breadth of vessel	27 2	27 3
Over paddle-boxes	49 6	43 6
Depth in hold	14 9	15 5
Draught of water forward	8 10	9 2
Ditto, aft	9 2	8 7½
	No.	No.
Burthen in tons	670	719
	ft. in.	ft. in.
Diameter of paddle-wheel	25 0	28 0
Breadth of ditto	9 0	6 0
Area of ditto	33 9	27 0
Dip of ditto	5 6½	5 6½
Area of midship section	190 0	——
	Miles.	Miles.
Speed with tide	21½	——
Ditto against tide	15¾	——
Mean speed	18⅝	16½
	ft. in.	ft. in.
Diameter of cylinder	6 0	6 0
Length of stroke	5 6	5 6
Horse power	350	350
Revolutions per minute	30	25½

RECENT AMERICAN PATENTS.

[Selected from the *Franklin Journal*.]

FOR IMPROVEMENTS IN THE DRILL FOR PLANTING WHEAT. *Henry W. Smith.*—The patentee says—"The nature of my invention consists in so constructing the drill as to raise the teeth when not in use for the purpose of conveying it from place to place, and in forming the seed-distributing cylinder in two parts, so that the wheels can be attached directly to the cylinder, while at the same time they have a motion independent of each other—the quantity of seed to be distributed being regulated by means of a sliding concave attached to the front of the said hopper."

FOR A MACHINE FOR MAKING SHEET METAL GUARDS FOR COP SPINNERS. *William Cundell.*—This invention consists in griping and bending the end of a strip of tin (to form that part of each which makes the connection with the one next it) on a permanent die, by means of a jointed bender, the faces of which correspond; then bending it over the curved edge of the bender into a semi-cylindrical cavity in the upper part of this bender by a cylindrical die jointed to the stand on the opposite side of the permanent die to which the bender is jointed, and then completing the cylindrical bend over the other portion of the cylindrical die by a hollow segmental former, jointed to the bender above the semi-cylindrical cavity thereof.

FOR AN IMPROVEMENT ON TIDE WATER WHEELS. *Thomas Rowand.* — *Claim.*—"I do not claim to have invented the adoption of a gate for turning the water upon the wheels; but what I do claim as my invention is, the construction and adaptation of the two gates in the mode specified, alternating with, and successively acted upon by, the tides, in combination with a wheel, as described, so that either the ebb or flow will find one of the gates, which serves as a guide-water towards the wheel, without changing the direction of motion of the latter."

IMPROVEMENT IN WATER WHEELS. *Hiram Munger.*—*Claim.*—"I am aware that the water has been discharged from a wheel at the bottom near the outside and inside at the same time; but in that case it was discharged downward, or fell from the lower edge of the buckets, and through openings in the permanent bottom over which the wheel moves, they (the buckets) being projected beyond the shrouding of the wheel into the shute which lets the water into the wheel.

"But what I claim as my invention is, the employment of a wheel having the shroud-

ing extending out to the periphery of the buckets, which are open inside and outside when combined with a three or more sided flume surrounding it, which flume is provided with a shute on each face to discharge the water into the wheel outside at given distances apart, leaving sufficient room between the shutes for the discharge of the water in tangential lines from the outside of the buckets, substantially as herein described, whereby the water is discharged mainly from the outside of the buckets, when the wheel moves with a velocity equal, or nearly equal, to that of the water by which it is impelled, and mainly inside when it is loaded, and moves much slower than the water by which it is impelled, as described."

For Improvements in the Turbine Water Wheel. *Theodore R. Timby.*—*Claim.*—"I claim making the two rims or flanches that envelope each other so as to constitute the two passages and issues for the water with their inner surface of the gradually decreasing eccentricity, herein described, whereby the water may continue to act on these eccentric surfaces, as its motion from the centre of the wheel is gradually diminished, at the same time gradually decreasing the width of the passages between the flanches inversely, as their length is increased by the increased diameter, as described.

"And I also claim making the outer extremity separate from the rims or flanches, so that they can be removed, and others of different lengths substituted, as described, that the wheel may be adapted to the varying capacity of the column of water."

For an Improvement in Rotary Shears for Cutting Metal. *L. and L. J. Lamb.*—*Claim.*—"What we claim as our invention is, the inclination of the two arbors of the rotating shears to the plane of the plate to be sheared, so as to leave a free passage for that part of the sheet that is being cut off, in combination with the bevelled face of one of the shears, as herein described. We also claim the mode of setting the cutting edges of the shears to each other by having the arbor of one of them to slide in its bearings, and forced up by a set screw, in combination with the spring that draws it from the other cutter, to prevent the injurious action of the cutting edges on each other, and to admit of their relative adjustment of the two cutters, as described."

For Improvements in Machinery for Cutting Wood Screws. *Thomas J. Sloan.*—The object of this invention is to cut the threads on pointed wood screws, so as to form the thread on the conical point with all the turns at equal distances apart, and of a gradually reduced depth, the cone of the thread being gradually merged in the cone of the core. This is effected by causing the cutting edges of the chasers that cut the upper and the under surface of the thread gradually to approach the pitch line of the thread, as they approach the apex of the conical point.

Claim.—"What I claim as my invention is retarding and accelerating the motion of the alternate cutters in making pointed screws, substantially in the manner and for the purpose set forth.

"I also claim the employment of a series of cutters acting alternately on the blank to cut and finish the thread of the screw, as set forth, all placed upon the same side of the axis of the screw blank."

THE INSTITUTION OF CIVIL ENGINEERS.

Mr. Field, the new President of the Institution of Civil Engineers, held his first *conversazione* on Tuesday evening, in the rooms of the Institution, Great George-street. The company was exceedingly numerous, and included nearly every person of eminence in the engineering and scientific circles. The display of models was, as usual, surpassingly good; indeed, we may venture to say that it was such as could not be equalled, or even surpassed, by any other institution or country in the world. Foremost among these were models from the workshops of Messrs. Maudslay, Son, and Field, and Messrs. Seaward and Co., exhibiting all the latest and most important improvements in paddle-wheels and screw propellers. The tubular bridge of Mr. R. Stephenson—that *chef-d'œuvre* of modern engineering—was represented by a beautiful model of Conway Bridge and Castle. A model, by a Mr. Clarke, of the *Great Britain* steamer, served to show—if not the utility of such leviathan constructions—the wonderful perfection to which miniature representations of machinery may be carried by mechanical ingenuity and skill. Although not more than six inches in length, it exhibited the huge vessel, with its four engines in full work, making the circuit of a mimic basin of water, and stopping, reversing, and going ahead at the pleasure of the attendant engineer. The engines were worked by compressed air. Electro-telegraphy had its natural representatives in Mr. Bain, Mr. J. Brett, and Mr. Reid; the model of the

first exemplifying his marvellously rapid chemi-hieroglyphic system of notation; that of the second, the ordinary letter printing by electricity; and that of the third, the application of electric telegraphs to factories, public offices, counting-houses, club-houses, hotels, taverns, &c. A model of a knitting machine, by Mr. Whitworth, of Manchester, attracted perhaps as much attention as anything in the rooms. How ladies, had they been present, would have relished this exemplification of the *sort of machine* to which most of them now-a-days are in the habit of reducing themselves—for many hours every day in their lives,—we presume not to conjecture. We can only say, that no living machine of the sort could have been more admired. Many more models there were, well deserving of record and encomium, but our limits compel us reluctantly to bring our enumeration to a close. While a line or two is yet left us, let us not forget to give to Mr. Manby, the Secretary of the Institution, the praise which is his due for the general excellence of the arrangements, and the good taste by which on this, as on previous occasions, he contrived at once to please every one, and to ensure the pleasure and comfort of all.

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Wood, of Cranmer-place, Waterloo-road, Surrey, carpet manufacturer, for improvements in weaving carpets and in printing carpets and other fabrics. May 30; six months.

William Seaton, of Camden Town, Middlesex, gentleman, for improvements in closing tubes and in preventing and removing the incrustation in boilers. May 30; six months.

William James Barsham, of Stratford, Essex, for improvements in the manufacture of mats. June 1; six months.

Thomas Hunt Barber, of King-street, Cheapside, for improvements in machinery for sawing wood. June 1; six months.

Richard Christopher Mansell, of Grange-road, Surrey, gentleman, for certain improvements in the construction of vehicles used on railways or on common roads. June 1; six months.

Thomas Burdell Turton, of Sheffield, for certain improvements in machinery for bending and fitting plates or bars of steel, iron, and other materials to be used for locomotive engine and carriage springs and other purposes. June 1; six months.

Joseph Wheeler Rogers, of Nottingham-street, Dublin, for certain improved methods and machinery for the preparation of peat as a fuel, and in the combination of certain substances as a compost or manure. June 1; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
May 29	1458	John Tongue	Parade, Birmingham	Brooch fastener.
30	1459	William Bonser	Kinolton, Nottinghamshire	Drain pipe.
„	1460	Michael Scott	Liverpool Corporation Water-works, Liverpool	Design for a water cock intended principally as a hydraut for watering streets, supplying shipping, fires, &c.
„	1461	George Simpson	Glasgow	Safety winding and detaching catch for mine shafts.
„	1462	William Webb and William Greenway	Birmingham	Knob cupboard-turn.
31	1463	John Brayton	Crookholm - mill, Sebergham, Cumberland	Mill stone.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1296.] SATURDAY JUNE 10, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

Fig. 1.

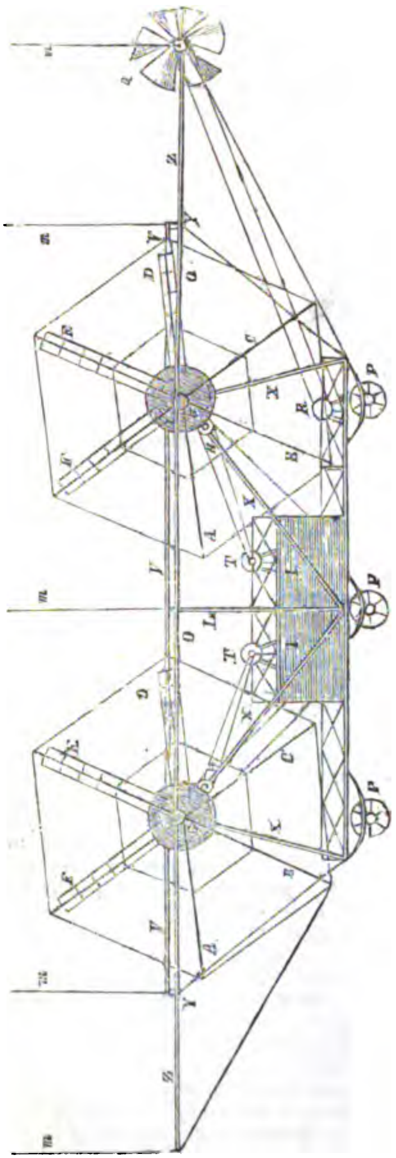
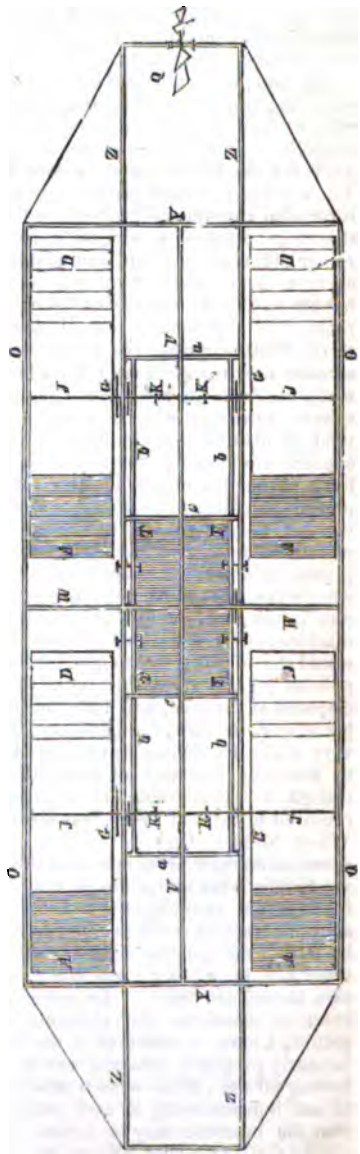


Fig. 2.

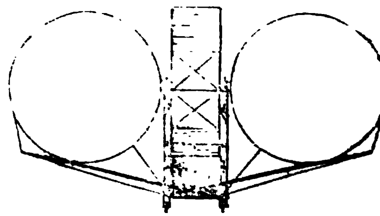


PITTER'S ARCHIMEDEAN BALLOON.

Sir,—In my last two letters on aërial navigation, I expressed a hope of devising a modification of the Archimedean balloon, such as would render it more likely to succeed in practice. Certain objections made by some of your correspondents concerning the equilibrium and steering of my machine, I replied to at the time, and apparently succeeded in removing the difficulties started on those points. Still, however, the weight of the propelling power threatened to be too great for the lifting force to cope with. The vicinity of the gas-bags to the engine-room also appears objectionable. I have therefore planned a navigable balloon rather different in form, and adapted to carry a large quantity of gas without having any in the vicinity of the engine-room. In my former plan I was deterred from proposing the adoption of an aërostat much larger than the hull of the machine, from an idea that the atmospheric resistance would, in such a case, tend to disturb the equilibrium. This apprehension having proved unfounded, I have planned a large aërostat for the present machine, to be placed at any convenient height above the deck. The engine-room is diminished in size, and placed low down. The paddles and guide-wheels are worked by running gear. It was stated with regard to my former machine, that a rudder of any kind would be of little use to keep it always pointed in the right direction. This I disputed at the time, and am equally disposed to do so now, for I conceive that a very slight disturbing force is sufficient to alter the direction of a balloon, although a considerable force may be required to carry it on in that direction. When Messrs. Gay Lussac and Biot ascended on their aërostatic expedition in 1804, they were obliged to be very careful to avoid agitating the car, "for the slightest motion, such as that produced by letting the gas escape, or even that of the hand in writing, was sufficient to turn the balloon aside." In order, however, to overcome the objection altogether, I have, in addition to the screw formerly proposed, adopted the plan of having all the paddle-wheels made so as to act independently of each other; so that the machine may be turned to the right or left, by giving different velocities to the wheels on either side. Each paddle-wheel has its own guide-wheel, by the use of which, any inclination of the machine may be rectified. For a fuller description of the details, the reader is referred to the *Mechanics' Magazine* for June 5, 1847, (No. 1243.)

Fig. 1 is an elevation of the improved Archimedean balloon; fig. 2 is a plan, and fig. 3 a cross-section of the same.

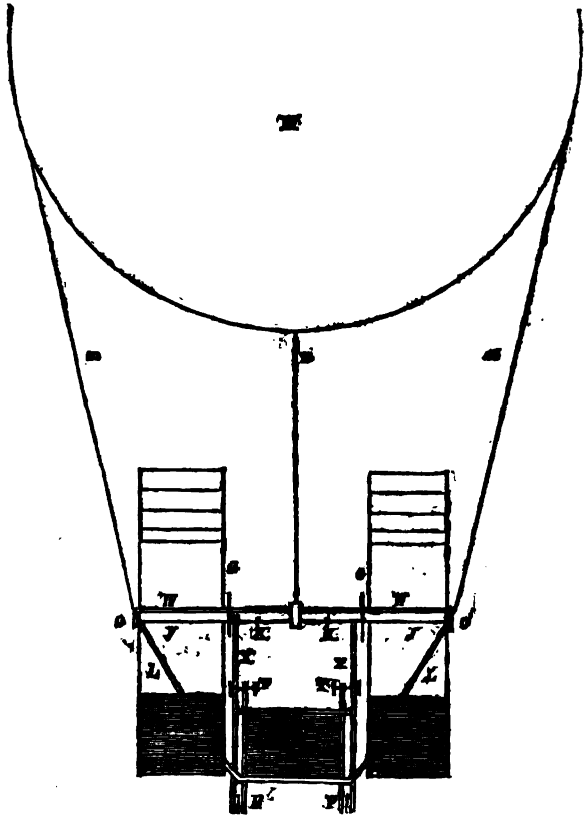
Fig. 3.



Those who have perused the account of my former machine will have little difficulty in understanding the present; I shall, therefore, be brief in my references. A, B, C, D, E, F are the arms of the paddle-wheels; G, guide-wheel. H and T, wheels for working G; I, the engine-room. The beams marked X, help to support the paddles, and carry on their summits a long beam, Z, on each side of the machine. Y, W, and Y are three transverse beams, resting their extremities on the two Z beams; V is a longitudinal beam, resting on the three transverse beams. An arm depending from V in each place where it crosses the paddle-wheel axles, JJ, furnishes a socket for them to work in. Each axle terminates in this arm, and thereby can move independently of its fellow. K K are wheels fixed to the axles, for the purpose of carrying running gear to work the paddle-wheels. L L are two sloping beams, serving to support O O, beams which receive the outer extremities of the paddle-wheel axles. Q is the screw, and R a wheel to work the same by means of running gear; *a*, *b*, *c* are beams forming the foundation of the machine; M, the balloon, and *m m m* ropes to the same. I have raised the wheel, T, in the present plan, so that it may be turned by a winch; the manner of locking it may be readily contrived according to the method for-

merly proposed, although some modification would be necessary. It would be best for the catch to be fixed at the wheel H, a bell-wire passing along X, and the top of the engine-room to the vicinity of the wheel T. This bell-wire might be worked by a foot lever and spring, as before.

Fig. 4.



I have not represented the aërostat in the elevation, for fear of encroaching too much on your pages. The form I have in view is the same as before, viz., a cylinder terminated by hemispheres, the length of the cylinder to be equal to that of the machine. Considering my plans as drawn on a scale of 20 feet to an inch, the diameter of the aërostat will be 60 feet, and its length, exclusive of the hemispherical ends, 120 feet. The total content, including hemispheres, will therefore be 452,172 cubic feet, and considering a cubic foot of hydrogen gas as having a buoyancy of one ounce in common air, the total buoyancy will be 12·61641 tons. Should this buoyancy prove insufficient, a larger aërostat must be employed, and I do not see why one much larger may not be used. As to making such a mass arrange itself in the right direction, I have little misgiving; the main difficulty would be to overcome the atmospheric resistance so as to give the machine a useful velocity.

Various plans and modifications have suggested themselves to me during the last few months. The form of the machine appears to favour the use of the inclined plane, so as to turn part of the

atmospheric resistance to good account, on the principle employed by Mr. Henson in his aërial machine. I have also thought of a machine with two paddles placed over the deck, one before the other, with an aërostat fixed on each side of the framework. I have planned a contrivance of this kind, which, with a weight of framing probably not exceeding that of the present one, will carry sufficient gas to bear up rather more than 19 tons. Fig. 4 is a section of the same. By a different arrangement of the outriggers, larger aërostats may be employed, so as to procure a much greater buoyant power. The lines of propulsion and atmospheric resistance may be made to coincide. I got my plans for this machine ready in August last, and was about to forward them, when the fear that the confined situation of the paddle-wheels might be made an objection debarred me from doing so. But I think it may be urged that as the apparent wind is always "right-ahead" to the machine, the current of air will rush so freely between the aërostats, that the propelling machinery would lose little of its efficiency.

In conclusion, I may perhaps be allowed to observe, that the form of paddle-wheel which I have invented might be applied to other purposes besides that of aërial navigation. It readily suggests itself for doing the work of a windmill, either in a horizontal or vertical position. In the former case the guide-wheel would require shifting by means of a vane or fan-tail, and in the latter case the whole machine would require to be under the control of such an apparatus. It might be called a "total-immersion paddle-wheel," since it acts when totally immersed in any running fluid. It would rotate at any depth below the surface of a river, thereby avoiding that raising of the swell caused by ordinary water-wheels. If used for propelling steamers, the floats might be made to arrange themselves in the best position for beating the water and passing through the air, and the speed of the steamer might be regulated by the guide wheel should it be found advantageous.

I remain, Sir, yours very respectfully,
JOSEPH PITTER.

Launton, near Bicester, Oxon,
January 19, 1848.

ELONGATED RIFLE SHOT.

Fig. 2.

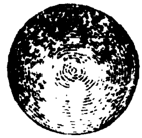


Fig. 3.

Fig. 4.

Fig. 1.

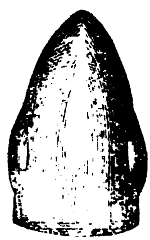
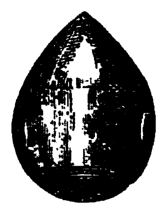


Fig. 5.



Dear Sir,—As there has been some talk lately of forming corps of volunteer riflemen, some of your readers may be interested in a few observations on a rifle shot which possesses extraordinary merit.

I do not propose at present to trace the progress of elongated shot until they have assumed the form now adopted, but to lay before your readers some of the facts as they stand. For this purpose I make the following extracts from the newspapers of the period, which contained the common semi-official reports of the trials on the practice ground in the Arsenal at Woolwich:

[From the *Morning Chronicle* of May 22, 1846.]

"Woolwich, May 21, 1846.—Experiments were carried on in the marshes on Tuesday and Wednesday, with a new pattern ball for rifles, the invention of Mr. Lancaster, and the result appeared favourable, compared with any previous experiments of

shooting from rifles at long ranges. The ball weighs upwards of one ounce and three-quarters, and is formed in the shape, or nearly so, as a sugar-loaf, with projections for the grooves of the rifle. A stand was erected yesterday, from which twenty-four rounds were fired, at a range of 1200 yards, and five balls out of that number went through the target, and all the others the entire distance."

The writer of this report appears to be less conversant with the modes of expression usually adopted in English society than might have been expected from a man of the world and a member of the Board of Ordnance. It is easier to wield the cat-o'-nine-tails than the pen; and here is another specimen of the literary abilities of one of the gallant reporters (date 1846.)

"Experiments at Woolwich Marshes.—Mr. Lancaster, jun., carried on experiments on Tuesday, with the rifle ball submitted by him in the form of a sugar-loaf. The experiments were made in the presence of Lieutenant-Colonel Dundas, C.B., who appeared highly satisfied with the result. About 40 rounds were fired, some at 1,200 yards, some at 900 yards and 600 yards. The whole of the firing was very good, and at 1,200 the balls entered the target to the depth of an inch. The first three rounds at 900 yards entered the bull's-eye, the aim being very correctly taken, and the form of the ball insuring a true course at that considerable distance for small arms."

The military authority who writes thus of "a rifle ball submitted by him in the form of a sugar-loaf" will perhaps be astonished to learn that a general conviction exists that balls are round, and not in the form of sugar-loaves. In consequence of such paragraphs as the above, Mr. Lancaster's invention has been made known on the Continent and in America, and if a war should break out, it is not impossible that the writers of those paragraphs may be convinced of the advantages of Mr. Lancaster's shot, by receiving specimens of them in the wisest feature of their distinguished persons.

Yet from these semi-official notices, we can discover that Mr. Lancaster did what had never been done before, namely, hit the bull's-eye at the extraordinary and unprecedented distance of 900 yards, and if he struck the target at 1200 yards only three times out of twelve he has a claim to be considered as the first rifleman in Europe.

I have now the pleasure to forward to you a cast from one of the moulds that are sold by Mr. Lancaster (see fig. 1,) and also a felt wad (fig. 2 and 3,) that has been fired with it. This wad is double concave, and serves to direct the force of the explosion as nearly as possible in the line of the axis of the shot. The lead is also wrapped in the usual linen patch, and it is needless to inform your readers that the wad is rammed down on the powder, and that the shot is placed on its patch and pressed down upon the wad with as little force as possible. It is found that this shot never turns over in its flight, and that the sharp head, of course strikes the object.

Of the nature of the algebraic curve employed, nothing has yet been published by Mr. Lancaster or any one else, that I have heard of. It appears to me tangential to the parallels that coincide with the sides of the barrel of the gun, and there is reason to believe that the expression for the length of the axis is a function of the velocity. The length of the axis admits of small variations from the figure here given, without detracting from the accuracy of the fire. A minute increase of length by no means deteriorates from the perfect effect.

It has been shown by repeated experiments, that the solid which passes most freely through water, approximates in form to the parabolic conoid. But water may be regarded as a non-elastic medium, and the velocity of any body through it may be considered as slow in comparison with the passage of a body impelled by gunpowder through the air, which is a medium highly elastic. A high velocity or low velocity—an elastic or non-elastic medium—involves very different data, and certainly very different curves.

The curve depends on the law of resistance. Conversely, the law of resistance may be inferred from the curve.

The lower part of Mr. Lancaster's shot is a cylinder fitting the barrel of the gun. Above the cylinder a conoid arises, which has hitherto been determined by experiments alone. If it is a solid of revolution upon the axis major of an ellipse, it is the figure proposed in my paper, printed in the Magazine in 1846 (vol. xliv., p. 439.) If not, it is a transcendent curve, dependent

for its form on the law of resistance of the air. Experiments are in progress that will ultimately decide this point, and as the law of resistance enunciated by Professor Davies, in a late number of the *Mechanics' Magazine* (vol. xlvii., p. 410) has attracted a good deal of attention, I am not without a hope that something decisive both as to the mathematical details and a comparison between the results of his theory and experiments, carefully conducted, may be laid before the public at a period not far distant. The precision that can be attained by means of this shot might be found valuable in testing any theory. In a specimen I send, which was fired at 250 yards into oak (see fig. 4,) the projections that fit the grooves are not stripped by the sharp edges of those grooves, but, on the contrary, are scarcely cut. Each groove is nearly one-eighth of the circumference of the barrel in width, and may safely be made much narrower.

It is a known principle, that all bodies moving in a fluid have a tendency to revolve upon the shorter axis. This would prevent any great increase in the length of the axis of revolution.

The centre of gravity is obviously nearer to the base than to the vertex of this figure, and perhaps may be marked without any great inaccuracy at about one-third of the length of the axis from the base.

Many futile attempts have been made to imitate this figure in applying shots to various guns. I send you one of the failures (fig. 5,) which serve to show what people ought to avoid. As yet the kind of shot above described has been fired from the two-grooved gun, and, being more than twice as heavy as the common ball, it requires the barrel to be strongly reinforced at the breech, lest the heavy charge of powder should burst the gun. The felt wad assists materially in keeping the shot straight, and preventing any irregular friction between the lead and the barrel; and in loading with this wad, much of the soot is carried down the barrel by the roughness of the felt, in each successive charge.

I remain, Sir, yours, &c.,

C. A. H.

Hunter-street.

INSTRUMENT FOR ASCERTAINING THE SPECIFIC GRAVITIES AND WEIGHTS OF BODIES. BY MR. R. W. FOX.

[From the *Transactions of the Royal Cornwall Polytechnic Society*.]

The instrument is represented in the accompanying figures. It consists of a conical vessel, A, (fig. 1,) which may be made of tin plate, or of copper, earthenware, or glass, &c., furnished with levelling screws, S, S, S, and having a glass cylinder, B C, cemented into it. The larger divisions on the cylinder indicate *thousands* of grains of water at about 60° Fah., carefully ascertained, and the smaller *hundreds*, and marked from 0; the most clearly defined part of the surface of the water having been first made to correspond with zero (0,) by means of the cock L, from which it may be discharged in greater or less quantities, and in drops when needed. The scale, D F, agrees with that on the glass, and is parallel to it. This contrivance is intended to prevent errors in reading from parallax; and it may enable an observer to subdivide the small divisions on the inner scale according to the method adopted by Mr. Fox, in his dip circles.

Any body, heavier than water, introduced into A, will displace a volume of water equal to itself, and cause it to rise in the glass cylinder above *zero* at which it had been previously adjusted. The *weight* of this volume of displaced water will be indicated on the scale, and the amount of this *weight*, employed as a division of the *weight* of the body out of water, will give its specific gravity.

The cup, G, may be conveniently used for containing the body, the specific gravity of which is required to be known; the cup having been first sunk in A, and the level of the water adjusted at zero. It may then be drawn up by a fine string to receive the body, and both be sunk together in the water in A.

Fig. 2 represents a long cylinder closed at the bottom, and of considerably less diameter than the cylinder, B C. This apparatus may be used for ascertaining the weight of a body in *air*, by causing it to float, first without the body, in the water contained in fig. 6, and adjusting the level of the water at 0, by the cock; then put the body into fig. 2, and the height to which the water rises between the cylinders, read off on the scale, will indicate the weight of the body in air. It is important that the space for the water, or interval between the enclosed and enclosing cylinder should be uniform all round; and this object may be effected by means of loose rings, *r r*, which should rest at or near the ends of the cylinder B C,

Fig. 1.

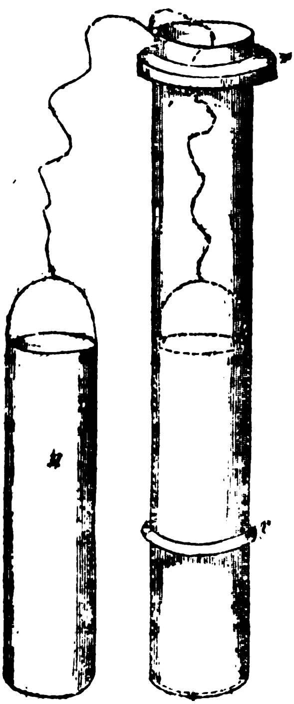
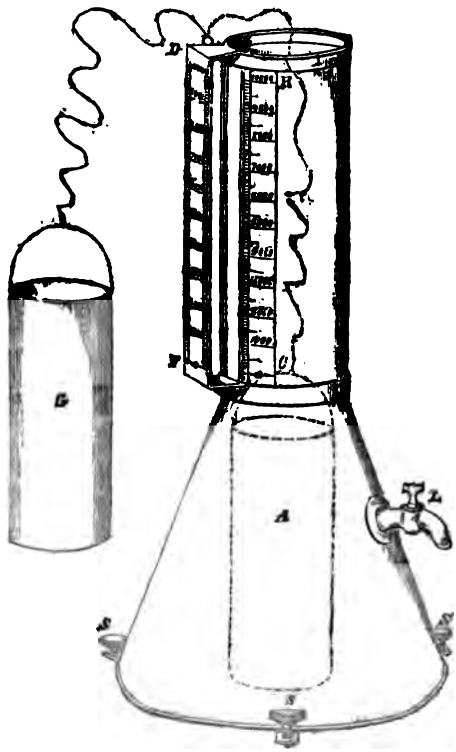


Fig. 2.



and admit of the free vertical motion of the enclosed cylinder, fig. 2. A cup or cylinder, H, may be employed to contain the body to be weighed, the cup being raised from the bottom of fig. 2 after adjustment, by means of a string, and then let down again with the body in it.

The apparatus may be made of sufficient size, to weigh both in air and water, considerable quantities of iron ores, or any other ores, mixed with foreign substances; and the relative richness of the samples may be deduced from their specific gravities.

ISOTHERMAL STILL-OVEN.

Sir,—There are many processes in the arts in which a uniform temperature is required to be maintained for a considerable time; some of these operations demand great heats, while the presence of mechanical force is not only useless, but inconvenient, or even highly dangerous.

Chemical baths for certain temperatures are as old as the sea; *e.g.*, for those at which water and saturated solutions of certain salts boil; and for those at which fixed oils decompose rapidly; but these give us but few points of the scale: saline solutions have many inconveniences in practice, and the heat of oil-baths is very indefinite. High pressure steam affords the means of commanding the required conditions approximately in some cases, but involves of necessity the non-requisite conversion of heat into explosive power.

A method is here offered, which will be found to present the desired conditions—the means of maintaining a bath or oven constantly at any required temperature, from about 160° Fah. up nearly to the boiling point of mercury,—without the production of half a mouse power of disruptive energy. It is simple and inexpensive.

It is not necessary that we should discover fluids having boiling points at every degree of the thermometric scale. The purpose is served by any mixture of two or more liquids soluble in each other, the boiling point of one of which lies below, and that of another above the heat required. If such a fluid is set on the fire in an open vessel or in a retort, it will begin to boil at a temperature somewhere above the boiling point of the most volatile substance it contains; and the temperature will gradually rise as the more easily vaporised part goes off, and this proceeds till the temperature reaches more or less nearly the boiling point of the least volatile matter present in the mixture. If, however, at any period of the operation, the vapours are prevented from escaping, by condensation—not by physical force pressure, but by the gentle persuasion of cold—and as they rise are continually returned to the boiler in the fluid state, it is clear that the heat of the mixed liquid (which is under unalterable orders from the Great Constructive Chemist, not to rise above any given temperature, under given pressures, till it has expelled from within it so much of it as is volatile under those conditions,) will cease to increase; and that, therefore, so long as the *vis a tergo* of the fire keeps it up to the mark, the temperature must remain constant.

Now we are provided in very reasonable abundance with such fluids. Mixtures of pyroxylic spirit or alcohol with water will begin to boil at various temperatures, according to the proportions of spirit to water. Pyroxylic spirit which will begin to boil at 160° Fah., may be purchased at 5*s*. or 6*s*. per gallon: and,—alas! for an excise, which has been almost prohibiting chemists from using alcohol in their laboratories, and permits a half-fed population of paupers to thin itself off with pennyworths of poison—gin is not very dear. Either of these spirits or mixtures of them with water will commence to boil at some temperature below 212° Fah. By heating such a fluid in a vessel, the principle of which will be described below, it may be kept boiling at the temperature at which it commences; or, by allowing the vapour to escape, and the temperature to rise, till it has reached any required point above that of first ebullition, and by then condensing and returning the vapour to the vessel in the fluid state, the heat may be maintained constantly at any point between that at which the mixture commenced to boil and 212° Fah. For higher temperatures we are supplied with regulators by many mixtures of volatile hydro-carbons, such as native naphtha, the oils of wood-tar, &c.; but especially by the oils distilled from coal tar, which enable us to command any point from 180° Fah. up to 550° Fah. If any temperature between the boiling point of water and 400° Fah. is required, all that is nessary is to take a convenient quantity of light coal naphtha, to distil it with a thermometer in the retort till the temperature has reached the point sought, then to stop the operation and to use the residue as the regulating fluid. The light coal naphtha usually begins to boil at about 200°, and the temperature rises to about 300° or 400°, before all has boiled away, according as the naphtha is rectified or crude. The rectified material is sold at about 2*s*. 6*d*. or 3*s*. per gallon, and the crude at about 1*s*. 6*d*. Temperatures between 180° and 220° Fah. may be commanded by the use of the very volatile oil (*Benzole*) which may be obtained from the naphtha by receiving separately the portions first distilled from it. For temperatures between 350° or 400°, and 550° Fah., the heavy oil of coal tar, which comes over after the light naphtha has been worked off, is an excellent regulator; it commences usually to boil at about 300°, and the temperature rises up to 550° before all has evaporated. This "dead oil" may be purchased at 3*d*. or 6*d*. per gallon. Heats higher than these—above the boiling point of mercury—may be maintained by charging the apparatus with some of the substances, even less volatile, which are obtained by distilling the pitch which remains when the heavy naphtha has been drawn off; but these are more difficult of management, and require thermometers not dependent on the expansion of mercury.

The accompanying figures represent the principle of the apparatus. Fig. 1 represents an arrangement for keeping a horizontal cylindrical oven at a uniform temperature; and fig. 2, a pot or bath, fitted with similar appliances. A is the chamber or vessel required to be heated; B, the bath, or still-boiler, through which heat is conveyed from the fire, C, to A;

Fig. 1.

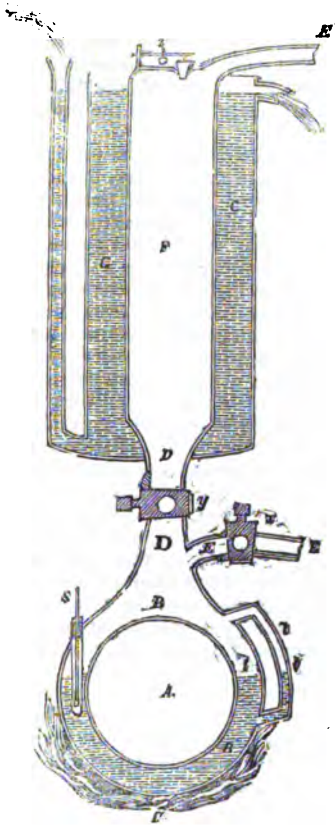


Fig. 2.

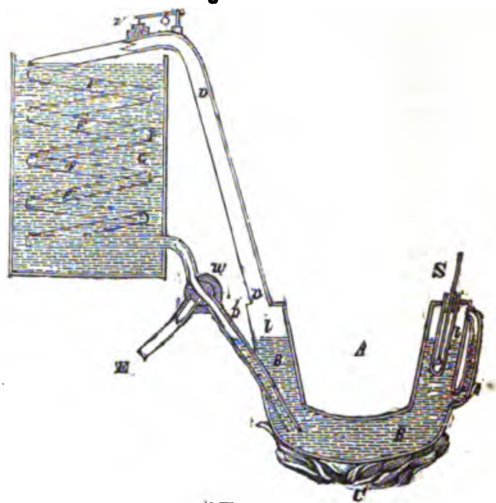
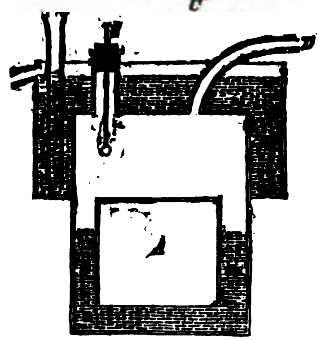


Fig. 3.



B is supposed to be filled with fluid up to the level, *l*, which may be observed by the glass tube, *t*, connected with B; *s*, a thermometer, which may be inserted in any convenient manner, and is here represented as placed in a tube closed at its lower end, and fixed air-tight into the top of the boiler, the thermometer passing through a cork in the open end of the tube. D, the neck which leads to the upper condenser, and through which, in fig. 1, the condensed fluid flows back to B; E a neck or pipe through which vapour may be conducted away from B to a still-worm and separate receiver, if required, and which is closed by a tap, *x*, when the temperature is required to be constant. F, the reverberating condensing vessel (which, in fig. 1, is a chamber, and in fig. 2 is a worm) from which the condensed fluid is returned through D^1 to the boiler. F may be provided with a lightly loaded safety-valve, *z*, so that the vapours may escape if they are at any time given off more rapidly than condensation takes place; or F, in fig. 1, may be provided with an additional pipe, E^1, through which any vapour which escapes condensation in F, may be conducted off to a separate condenser. G, the cistern which surrounds the condenser, and which is kept full of water, which, if the temperature required in A be lower than 212° Fah., must be as cold as possible, and constantly renewed. If the heat required in the bath be above the boiling point of water, the water around the condenser need not be renewed, but may be allowed to rise in temperature till it boils, and may be gradually replenished as it evaporates. The heat rendered "latent" (as the

phrase goes,) *i. e.*, converted into atomic repulsive force in the ebullition of the water, is quite sufficient (if the condenser be large enough in proportion to the boiler, and the fire be not too fierce) to cause all the oil vapours from which it is abstracted to revert to the liquid state, when these are the vapours of fluids having boiling points higher than that of water.

Fig. 3 represents a simpler apparatus suited to laboratory work on the small scale. A is the oven or chamber to be heated; B, the boiler, which surrounds A, and is simply surmounted with an outer vessel or jacket, G, open above, and supplied with water, which will condense all the vapour that rises from below, and return to the boiling fluid. D, the escape pipe for any uncondensed vapour; S, the thermometer, reaching to the interior of A.

Let us now suppose that a temperature of 450° Fah. is required to be constantly maintained in the oven, A, fig. 1. A quantity of heavy coal naphtha sufficient to fill the boiler, B, to the highest level of the gauge tube, must be poured in. The cocks are turned—*y* off, *x* on—and the fire is lighted. The oil will begin to boil at about 350°, and the vapours given off will escape by the neck, E (and will be condensed and received in a separate apparatus; all here received is kept apart in case a lower constant temperature is required in the bath at another time, when it, or a part of it, must be added to the bath-charge, and the preparation commenced as before.) As the distillation goes on, the temperature will rise, and more of the original oil must be added, so as to make up the proper quantity in the boiler. At last, the temperature will be found at the desired point, with a sufficiency of fluid in the boiler. The cocks must now be turned again—*y* on, *x* off—all the vapours now given off will pass into the chamber, F, and being there condensed will trickle back into the boiler, where they will be again vapourised, and this process going on in endless succession, the temperature will be maintained invariable at 450°. If, again, a constant temperature of 190° Fah. be required in the apparatus, fig. 2, the outer boiler, B, must be charged with such a mixture of pyroxylic spirit and water as will commence to boil a little below 190°; the three-way cock, *w*, must be turned, so as to open the passage from the boiler and the worm to the escape pipe, E, and distillation must be continued till the temperature reaches 190° Fah. The cock is then to be turned so as to close E, and pass all the fluid condensed in F back through the pipe, D^1, to B.*

It may seem dangerous to use inflammable fluids in this manner, but it must be remembered that the quantity required is not large, and that the whole is to be in tight vessels, having at most only one communication by a single pipe with the air, which, as in a common still, will of course be distant from the fire. The liquids which would be used for the higher temperatures are very slightly inflammable; a lighted candle may be held to the mouth of a still worm from which the hydro-carbons of coal tar, which boil at above 280° Fah., are running, without any inflammation ensuing; indeed, a burning torch may be plunged into a vessel full of these oils when cold, with no other result than that of extinguishing it. None of these substances will take fire except when in a state of vapour; and the very volatile ones alone give off sufficient vapour at common temperatures to enable them to kindle at a lighted match.

It will be seen too that the temperatures between 300° and 550° may be regulated more cheaply and easily than the lower; first, because the liquid employed is very inexpensive, and secondly, because the constant stream of cold water is not required for condensation. Neither is any of the material wasted, the same stock lasting for any length of time; the machine being always wound up and ready to start at the same temperature whenever required. The odour of the substances should form no obstacle to their use, as when once placed in the boiler they need never be exposed again, nor any removed, except by distillation, when a higher temperature is required. If, however, a purer material is preferred, the deodorising processes are simple, but it would be out of place to describe them here.

* A mixture of equal parts of water and of such wood spirit as boils at 160°, will enter on ebullition about 180°. In any case, a preliminary experiment, made with a couple of ounces of fluid in a small glass retort, with a thermometer, will give information as to the quantity of spirit requisite to bring down the incipient boiling point to a few degrees below, or even exactly to, the mark required.

Hoping that this suggestion of an apparatus, which might be called an isothermal still-oven, may not be useless,

I remain, Sir, yours, &c.,

CHARLES BLACHFORD MANSFIELD.

90, Regent-street, London,
May 24, 1848.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?

[We gave in our last Number the Report at length of the Dover Harbour Commissioners. Our readers would observe, that to that Report there is appended the following short *note*:—"*Sir Howard Douglas and Sir W. Symonds decline to sign this Report.* Rear-Admiral Dean Dundas has been absent from England during the sitting of the Commission." In so far as regards Sir Howard Douglas and Sir W. Symonds, that note, however, expressed but half the truth; it should have gone on to say—"*and have respectively recorded the reasons for their dissent in papers which they have desired should be attached to their Report, but which the majority of the Commission have decided cannot be allowed.*" Etiquette is said to have required this suppression (though on that point there is a difference of opinion); but be this as it may, it is certain that truth did not require it, and exceedingly probable that the public interests could only be endangered by it. Already there had been sacrifices made to this same etiquette in the course of the labours of the Commission, which rendered it a matter of peculiar propriety that it should not stand in the way on the present occasion. Adopting the mode of procedure followed in courts martial, the youngest member of the Commission was first called upon to state his opinion, and the votes taken from the bottom upwards. All the main questions referred to the Commission were thus, in fact, decided by the jonior members of the Commission, before it came to the turn of Sir Howard Douglas and Sir William Symonds to give their votes, who therefore contented themselves with simply recording their dissent from the Report.—(*Letter of Sir Howard Douglas to the Secretary of the Treasury.—Parliamentary Papers.*) The Report, in short, was literally that of Messrs. Brandreth, Alderson, Colquhoun, and Washington—the four juniors—alone. Who knows but what all these juniors might have thought and voted differently, had they first heard what their distinguished seniors had to say on the subject—one of them, an officer, who is universally acknowledged to be second to none of the present day, as an authority on engineering matters? The way in which the opinions of Sir Howard Douglas and Sir William Symonds were thus shut out from their due influence on the decision of the Commission, made it the more desirable that their Reasons of Dissent should have been added to the Report; and it says but little for the confidence of the majority of the Commission, in the soundness of the conclusions at which they arrived, that they should have allowed "etiquette," or any other consideration whatever, to prevent them from placing at once *both sides of the question* before Government and the public. We now propose to supply the Protest of Sir Howard Douglas from a copy of it which has been sent to us accompanied with the following note:—

"*A Constant Reader of the Mechanics' Magazine*, and an admirer of that useful publication, transmits to the Editor a paper which has lately fallen into the writer's hands, and which contains so many important facts and observations on the controversy, "Whether Sea-walls should be Sloping or Vertical?" that the Editor will no doubt peruse with interest a paper which controverts the theory of a hazardous experiment by important facts, and the opinions of several practical engineers of great eminence and experience.

"This is a question not only of great scientific interest, but of national importance; and as the Editor has taken up the subject in his valuable periodical, he will no doubt prosecute it with a view to deter the undertaking of a great national work, upon a mere speculative and theoretical mode of construction, until the question at issue shall have been investigated and settled upon the best and surest principles and foundations."

May 19, 1848.

The Protest is divided into "Articles," the numbers of which correspond with the numbers of the paragraphs in the Report.]

***Protest* against the Decision of the Members of the *Harbour of Refuge Commission* present at the Sitting of the 13th January, 1846; and *Dissent* from their Report, on the part of Lieutenant-general Sir Howard Douglas.**

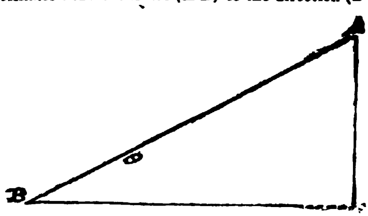
Dissent.

Article 1.—Attaching the greatest importance to the attainment of certainty in the mode of forming, and of durability in that of executing the extensive works about to be undertaken for the proposed harbour of refuge in Dover Bay, I consider it incumbent upon me to express my marked opinion in opposition to plans which, in my judgment, are founded on modes of construction not resting upon any proved principle, and untried upon any sufficient scale to warrant their present adoption, which are moreover theoretical in conception, and consequently uncertain in their ultimate result. Such plans are, in my opinion, unfit for the attainment of the great national object which we have in view; and which it is my most anxious wish to see undertaken in such a manner as will leave no doubt of its being successfully accomplished.

Article 2.—Considering, then, that the building of an upright wall in the open sea, in seven or eight fathoms water, is a proposition novel in theory, and never, in so far as I am aware, proved in practice, on any scale to warrant its adoption;* and being of opinion that a breakwater of the proposed elevation and magnitude, rising, with an upright face, from the depth of 42 feet at low water, would be far less capable of resisting the violence of seas,† and especially of broken seas (exposed as it must, moreover, be to the unremitting action of strong tides and currents) than a sloping

* See Observation, Article 6, on Kilrush Pier, built in only 9 feet 6 inches depth of water.

† The application of the theory of the resistance and impact of fluids is no doubt attended with great difficulties and anomalies in this as in many other cases connected with natural philosophy; but whatever results have been derived, either from theory or observation, they all agree in this, that the horizontal impulse of a fluid on any resisting body is increased, in a very high ratio, as the inclination of its surface (A B) to the direction (B C)



of the motion increases. The fundamental theorem is, that this varies as (sin θ)^2 (θ representing the inclination), because the height of the breakwater continuing the same, the quantity of fluid impinging on it will be the same at all inclinations. If the height of the breakwater were variable, the whole impetus would then be as (sin θ)^3, because in this case, not only is the force of each particle diminished in proportion to (sin $\angle \theta^2$), but the number of particles which impinge on the plane varies as sin. θ.

From this resolution of the pressure of a fluid against the surface of a body, whether either be in motion and the other at rest, or both body and fluid be in motion, some of the most useful results of practical science are obtained. By this a ship is impelled forward obliquely to the direction of the wind, even when that direction is before "the beam;" and a like resolution of pressure gives rise to the propulsive force of the revolving screw, or enables the rudder to retain and guide the vessel in her intended course. The oblique action of the water on the side of the vessel or raft, permits a "flying bridge" to be sheered across a river; and not only does that of the wind give motion to the sails of a mill, but by a proper variation of the obliquity of these, according to the distance from the axis of motion, the impelling force is rendered equably on every part.

In the application of this principle to practical mechanics, great difficulties certainly occur from our imperfect knowledge of the manner in which the forces of nature are exerted; and the problem concerning the action of the sea against a wall, can no more be solved by the resolution of forces than the trajectory of a shot, in a resisting medium, can be determined by the parabolic theory, or even by any theory founded on the usually assumed law of resistance; yet such a theory has its uses for the practical artillerist; and a knowledge of the mathematical principles of hydrodynamics is essential to an adequate conception of the means to be employed for resisting the actions of waves.

On the best form for the profile for a "breakwater" a difference of opinion exists; and while, on one hand, it is contended that the exterior face of the wall should be vertical, on the other, a face inclined to the horizon is recommended. The advocates of the former construction seem to consider that such a wall is subject only to the hydrostatical pressure of a fluid at rest, or that the agitations of the water before it, takes place only in vertical directions; but neither of these conditions holds good in Dover Bay, or wherever by the force of winds and currents the waves are impelled with violence against the shore. That loose stones constituting a breakwater, when deposited so as to form an inclined plane, should be occasionally displaced by the action of waves is sufficiently obvious; but that, with equal quantities of material, a vertical wall should resist the concussions produced by such actions, as efficaciously as one with an exterior slope, is inconceivable.

It does not follow, however, that the face of a breakwater should have one uniform slope from the bottom upwards; the part lashed by the waves in an open sea requires a longer slope, or a smaller inclination to a horizontal plane, than the part below; and this deduction from scientific principles by many eminent authorities is confirmed by the practice of engineers.

Poisson, Prony, Charles Dupin, Girard, Cachin; Professor Cape, Military Seminary, Addiscombe; Professor Narrien, Royal Military College; General Bernard, United States' Engineers; Commodore Rogers, United States' Navy; Mr. William Strickland. See Annex (M.), on the Delaware Breakwater, by which it appears that Colonel Jones was misinformed.—See his Report of 1846, Appendix, No. 1, p. 72, by the United States' Engineer, who told him that the long slope was not approved of by American engineers.

breakwater formed in a manner similar to that which has been successfully completed in Plymouth Sound (which is now in a state of perfect repose and stability) (Annex B. D.), as well as similar to others (Delaware Breakwater, Annex L.) constructed on its model; having also dissented from the proposition of the upright wall on a former occasion (31st July, 1844, Annex A.) I now consider it my duty to oppose myself, decidedly, to the adoption of that mode of construction, and to the employment of any artificial or inferior material, as a substitute for stone, from mere considerations of pecuniary economy. The latter should I think have no place in a great national undertaking of this description, and I firmly believe that the method proposed with this view would, in the end, prove by far the most expensive.

Article 3.—In the more recent minutes and proceedings of this commission, I find much to confirm me, practically, in these views and opinions (which I brought before the Commission in July, 1844,) and I perceive that even the highest acknowledged scientific authorities who adhere or incline to the theory of the upright wall, speak cautiously, diffidently, doubtingly, or ambiguously,* of the capability of vertical walls to resist the action of waves and seas in all cases and under all circumstances. Some of these maintain† that waves in a breaking state do act percussively; that a sloping breakwater is therefore best able to resist the action of seas in that state, and that consequently there should be a sloping breakwater in one part of the proposed harbour of refuge, and a perpendicular wall in others;‡ whilst other high authorities, who incline to the upright wall, admit that this is merely matter of opinion, quite speculative and experimental as respects themselves,§ and that there can be no doubt that a sloping breakwater would be perfectly secure.‖ Now, in my judgment, nothing purely theoretical can remove the strong objections which have been so forcibly advanced by many experienced practical engineers,¶ (and I may add other eminent men of high scientific and practical attainments, naval, military, and civil,) against the adoption of a mode of construction difficult if not impracticable, any failure in which would be discreditable to the engineering talent of the country, and in ruining Dover Bay as a natural roadstead and anchorage, be productive of evils the most serious to commercial operations in the Channel.

When the Commission reassembled to report upon the mode of construction, there appeared to be a strong disposition on the part of some of its members to listen more to theoretical views and speculative opinions, than to the only sure guides, actual practice and experience; and it further appeared that a majority of the Commission might be induced to decide, without further investigation or deliberation, in favour of propositions, as well with respect to the form as to the substance of the intended work, which, in my opinion, would be to sanction hazardous experiments with mighty interests on a prodigious scale, which nothing could justify. I therefore deemed it my duty to call for fresh evidence, and to re-examine those who had appeared before the Commission of 1844, so as to insure the utmost caution, the fullest investigation, and give time for more mature deliberation on the questions referred to us. That additional evidence affords strong proof of the experimental character of the projects to which I objected, of the difficulty of their execution, and even of the danger of failure.

Mr. Alan Stevenson states, that to build an upright wall in seven or eight fathoms water, so far as his experience goes, would be entirely an experimental measure; that to attempt this in an open sea-way like Dover Bay, would be a work of the utmost difficulty, if not wholly impracticable; and that so far from recommending the trial of such a work, he would humbly, but decidedly, dissuade the government from making an attempt which he was sure would end in failure; and, in reply to cross-questions put to him with a view to shake his testimony against the upright wall, he denies the theory on which that mode of construction is

* Professor Barlow's Letter, Article 19, p. 12, of this Paper; Appendix, No. 39, of the Report.

† Professor Airy, Astronomer Royal, Article 18, and Annex (H.)

‡ Professor Airy, answers to questions Nos. 558, 560, Annex (H.).

§ Mr. Hartley, civil engineer, answers to questions Nos. 702, 705, 769, 770, 771, Article 22 of this Paper.

‖ Article 20, p. 12.

¶ 1. Sir John Rennie, Annex (B.) See also his Report and Opinion, No. 4, of plans sent in.

2. Mr. George Rennie, Annex (C.) See also his plan, No. 2, of the Reports; his model and recent examination, Q. 430 to 434, 445 to 447.

3. Mr. Cubitt, Annex (D.) See his Report and plan, No. 6, and recent examination, Q. 210 to 213, 234 to 238; and letter to the Chairman, Appendix, No. 11, Second Report.

4. Mr. William Stuart, superintendent of Plymouth Breakwater, from the commencement of the work in 1811 to the present time, Annex (F.), evidence of 20 June, 1844.

An important evidence, showing that the damages which that work had sustained arose from the slope or foreshore not being long enough; stating his practical objections to a more upright slope, and his conviction that it could not stand; and that, if that breakwater had been constructed upright from the bottom of the sea, it would have been incapable of resisting the force of the waves.

founded. He asserts, on his own experience, that waves are not purely oscillatory, but have onward motion, and consequently percussive force, such, in his conviction, that any attempt to check their force by means of a vertical wall, will prove a signal failure; for that a force would be developed by the collision of the wave with the wall, whose amount will be found to surpass any which has ever been experienced on the face of a sloping breakwater.

In the course of the protracted discussions to which my opposition gave rise, the danger was demonstrated of using, in such a work, a material (concrete) to which I had always objected (Annex A.; see also Annex I., and articles in the Engineer's Professional Papers,) as deficient in tenacity, and incapable of resisting mechanical action of water. An opinion of the efficiency of this material was, however, strongly supported by the reference made in an official report, and in a leading question (No. 153)* to the use of blocks of concrete for the completion of the breakwater in Cherbourg Bay, which was described as a successful experiment, and one deserving of being adopted by us, as a precedent; but the contrary of both was soon made evident; for within the period to which, happily, the proceedings of the Commission were thus extended, an important failure occurred in the works at that place; and the employment of concrete, as a substitute for stone in this climate, has been abandoned by the French engineers.

This failure, and the opinion of Sir R. Smirke against the adoption of blocks of concrete as an artificial stone, which he thought would fail, disposed of this proposition; and it will not be conducive to the public interests, in my opinion, that the other description of artificial material recommended by Mr. Rendel (namely, brick set in cement), which Mr. Corderoy, contractor, states (Appendix, No. 24) would cost twice as much as concrete, and which Mr. Smirke says would be more expensive than stone, should be used.

With respect to the adoption of blocks of concrete;—far "from standing remarkably well in the breakwater at Algiers," the whole mass of the breakwater has settled bodily, not from the effects of gales of wind, but from defects in the material (which time will further show); this, there is no doubt, is occasioned by the chemical action of the sea, "which, in the Mediterranean, contains 7·92 per cent. of sulphate of magnesia, whereas the water in the ocean contains only 2·29 per cent., consequently, of two moles made of the same concrete, the one in the ocean may last an indefinite period, the other will dissolve in a few years; and even mixing puzzolana with the concrete will not guarantee the lime from solution." Nor can that work, under any circumstances, be cited as an example for our imitation on the coasts of Great Britain. There are no tides in the Mediterranean, and the climate there is well suited to the drying and consolidation of that material, which is not the case in more northern regions.

It may be added, that the form of the work at Algiers is not that of an upright wall, for its face has a slope of 45 degrees; the work, therefore, cannot be adduced as an example in favour of that form of construction.

Article 4.—The high scientific authority, to whom I have already referred (Professor Airy), and of whom it is impossible to speak but in terms of the greatest respect and deference, admits that he is not aware of any case in which a perfectly upright wall has been built in the open sea, in the depth of seven or eight fathoms; that such a mode of construction applies to Dover Bay, would certainly be an experimental measure; that it would be very difficult, though he does not think it impracticable, to construct such a wall, but that it does admit of a doubt whether it would end in failure, or, on the other hand, tend to public advantage; and therefore thinks that it is much to be wished that the experiment should somewhere be tried in order to determine that doubt.

This admits all for which I contend, namely, that the mode of construction recommended by a majority of the Commission is experimental, difficult of execution, perhaps impracticable, and detrimental in its results; that the experiment should be tried somewhere else on a sufficient scale, and for a sufficient length of time, in order to ascertain, positively, the result, before it is applied in any such national work as that for which a majority of the Commission have recommended it: but I dissent in the strongest terms against that experiment being made, by adopting that speculative mode of construction for the proposed harbour of refuge in Dover Bay.

Article 5.—In support of my dissent from the adoption of the upright wall, I appeal to the debate which took place at the Institute of Civil Engineers, in April, 1842*, on Colonel Jones's "Observations upon the Sections of Breakwaters as heretofore constructed, with Suggestions as to some modifications of their Forms." This debate may

* Captain Washington, December 3, 1845, Appendix, No. 23.

* Proceedings of the Institute of Civil Engineers, vol. 2, p. 124.

be taken as a very fair exposition of the opinions of practical engineers on the principle of the upright wall. A copy of that debate should, I think, have been inserted in our proceedings; but this not having been done, I supply the omission.

The president, Mr. Walker, took an important part in that discussion. He said, "It is evident that if the materials are deposited at an inclination, any portion being displaced, is only carried down elsewhere. Although, strictly speaking, it may not be wanted, it must nevertheless assist in consolidating the mass, and the vacant spaces can easily be filled up. Under similar circumstances (to those which displaced some of the stones in Plymouth Breakwater) a perpendicular wall would suffer more severely, and probably would have fallen entirely. He therefore considered that in situations like that of the Plymouth Breakwater, which was exposed to a heavier sea than Cherbourg, a long slope for the sea face was essential."

Mr. Palmer, vice-president, observed that the form suggested by Colonel Jones for the faces of breakwaters, did not appear sufficiently justified by observed facts; that the idea was entirely of a speculative character, and was contrary to the laws of nature, which should be the engineer's chief guide; and he attributed the failure alluded to by Colonel Jones, in the harbours of Ardglass, Portrush, &c., more to defects in workmanship, than to faults in the principle of the structure.

General Pasley said he conceived that a perpendicular wall, constructed of large ashlar work, well cemented, would assume the character of a rock, and all the prejudicial action of the receding wave would be avoided.

Mr. Bull differed entirely from Colonel Jones's opinion as to breakwaters with vertical or nearly vertical faces, because any disturbance of the footing, however slight, must have a tendency to overthrow the wall.

Mr. George Rennie deprecated in strong terms the upright wall, and stated that the late Mr. Thomas Telford had abandoned that mode of construction.

Mr. Vignoles only agreed to a certain extent to the form proposed by Colonel Jones, and recommended a combination of a slope below with a vertical parapet above.

Mr. Gordon was in favour of the slope; and stated that a sloping breakwater, composed of *pierre perdue*, with a sloping face, had withstood undisturbed the surf at Madras.

Mr. M'Neill adduced the long slopes of sand, at an inclination of 10 to 1, thatched with straw, which resist the waves of the ocean on the coast of Holland.

Thus we have in this discussion a majority of speakers of seven to two, in favour of the slope; and of the minority, one was for a combination of the slope with a vertical wall above. Even Colonel Jones suggested this modification. *See* page 125, vol. 2, Proceedings of Institution of Civil Engineers. Plan No. 5, proposed by him for Dover Bay, was of this description.*

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* *Note added by Sir Howard Douglas, 15 March, 1847.*—It is a remarkable circumstance, that at a recent meeting of the Institution of Civil Engineers, in which the theory of the upright wall applied to breakwaters was first propounded, that mode of construction should have been condemned with one exception only, Mr. Brunel, who admitted that he would no longer recommend it for breakwaters in deep water, either for economical or other considerations. And it is an instructive circumstance in the discussion which recently took place on this subject, as stated in the subjoined article, taken from the *Athenæum* of the 13th March, 1847, that Mr. Robert Stevenson, an eminent engineer, stated publicly that he had, in pursuance of his faith in the theory propounded at the meeting of April, 1842, constructed a sea-wall, of great height and thickness, nearly vertical, to secure that part of the railroad from Chester to Holyhead, which goes round the point near Penman Mawr; that, in a recent storm of wind, the waves struck the wall with such force, as to knock it down in a short period, as effectually as if it had been breached with cannon; and concluded his account by stating that he was now convinced of the folly of erecting perpendicular breakwaters.

"*Construction of Sea-walls and Breakwaters.*

"This subject, to which we alluded in our last, was renewed at a meeting of the Institution of Civil Engineers, on the 9th instant, in a paper by Mr. Scott Russell.

"Although agreeing as a general proposition, with the truth of the observation, that it was impossible to lay down any one undeviating rule for a form of sea-wall which should suit all cases, the author had, from long and careful experiment, and examination of various localities, endeavoured to classify certain forms of artificial constructions and to adapt them to certain cases, having reference in each case to the action of the waves to which they were to be exposed. His first process was to examine the action and character of the several kinds of waves, deducing as a given axiom, that,—*First*, the common form of waves is cycloidal. *Second*, the motion of the waves in a disturbed state is circular, and in a vertical plane. *Third*, the water near the top of a wave moves the same way as the wave itself *Fourth*, the water in the hollow between the waves is receding. *Fifth*, the power of a wave is exactly in proportion to the height of its crest above the hollow between the waves. *Sixth*, the greatest power a wave can exert is at the moment of the crest breaking over into the hollow. *Seventh*, waves in the British seas have rarely been seen of a greater height than 27 feet above the hollow, and 32 feet may be taken as their greatest unbroken height; those of the Atlantic being stated to range higher. *Eighth*, waves have never been seen of the full depth of the water forming them, hence it is deduced that the greatest force waves can be exposed to may be determined by the depth of the water they are placed in. *Ninth*, there are two or more classes of waves: wind waves, short, high, and superficial; and storm waves, which are long, low, and deep. *Tenth*, the depth of agitation caused by a wave is in the ratio of its height and length conjointly.

"Reasoning upon these data, the paper then pro-

Article 6.—I object to Kilrush Pier being adduced as a test of the principle of the upright wall sufficient to warrant its adoption in the construction of a harbour of refuge in Dover Bay. Kilrush is a small tidal harbour on the coast of Ireland for coasting vessels. The piers are built only 9 feet 6 inches depth of water at low tide. The foundations were laid without difficulty by the diving-bell, with large masses of stone, which were easily and quickly deposited. The area of the section of the wall is considerably greater than that of the old work; but so far from the upright wall having been built in consequence of the sloping profile, as originally proposed, having failed, Colonel Jones expressly says, "that the old work stood remarkably well."* There is nothing in this, therefore, either practically condemnatory of the slope, or sufficient to warrant the adoption of the upright face, on such a scale as that to which these proceedings relate. There is no doubt, as Mr. Palmer says, the piers of the small harbours which Captain Washington reports to have been so much damaged by the sea, were constructed in a very defective manner, and with materials of dimensions that ought not to have been put in, and it likewise appears that the damage which these piers may have sustained, might easily be repaired; but certainly no such errors would be committed in any new work of this description, far less in that great national work now under consideration.

Article 7.—The recommendation of a majority of the Commission in favour of the upright wall is stated in the Report to have been made on a summary:

1. Of the conflicting opinions entertained by the eight engineers whose plans for constructing a harbour of refuge in Dover Bay were submitted to the Commission; and

2. With reference to the opinions of those persons who had been requested to give their evidence or advice upon this important question.

The following is a list of the engineers whose plans for constructing a harbour of refuge in Dover Bay were sent in to the Commission:

1. James Walker; 2. George Rennie; 3. Captain Denison; 4. Sir John Rennie; 5. Lieutenant-Colonel Jones; 6. W. Cubitt; 7. Charles Vignoles; 8. J. M. Rendel.

Article 8.—1. Mr. Walker, civil engineer, is somewhat inconsistently adduced in the Report, page 7, line 10, as an advocate, in principle, for the construction of a nearly upright wall. The project submitted by Mr. Walker to the Commission* is to build these walls in immense vessels, or as he calls them "utensils," (*caissons*,) three or four hundred feet long, and seventy feet wide, containing two or three thousand tons of ready-made breakwaters, to be towed by steam tugs and stranded in Dover Bay! But we have Mr. Walker's authority, from what he said at the meeting of the Engineer Institute, on the 12th of April, 1842, (Proceedings of the Institute, vol. ii., p. 124,) that his reason for proposing nearly upright walls in this case, was to avoid the extravagant width which must be given to these huge utensils, if the walls have any considerable slope; for, at the discussion to which I refer, Mr. Walker stated, that in situations exposed, like that of the Plymouth Breakwater, to a heavier sea than that which rolls into the Cherbourg Bay, a long slope for the sea face was essential; and that had a perpendicular wall been constructed in Plymouth Sound, instead of a sloping breakwater, it would, in the storms which assailed it, have suffered more severely than it did, and probably it would have been entirely overthrown.

ceeded to examine two classes of hydraulic works. *First*, those which are designed to act upon the waves; and, *second*, those whose structures are exposed to the sea without any design of controlling it, but only to guide it under particular circumstances.

"Of the first class are sea-walls, piers, and other sea defences intended to restrain the action of the waves; for the forms of which a number of designs were given, ranging between the flat slope, with a foreshore, and the vertical wall. Of all these the preference was given to a wall having a concave or cycloidal curved face, to carry the wave up without breaking; overhanging coping, curved on the under side to return the wave upon itself, and a recessed parapet on the outside to prevent the wave from being thrown inside. For breakwaters, whose object it was to resist the waves and produce still water within side, the best mode, under all circumstances of locality, variety of materials, and cost, appeared to be the depositing of the large and small materials, and allowing them to find their natural slope under the action of the waves.

"Of the second class, are works designed to direct the scour at low water, but which are quite covered at high water: the foundations of lighthouses, &c.; the object being to oppose the least possible resistance to the waves, and to suffer the least from them. Groynes, embankments, and other works intended to be under high water, also coming under this class; the best form is the parabola with the foot curved outwards on each side, the apex being raised or lowered, and the base proportioned to its application. This form being extended upward approximates to that of Eddystone, Bell Rock, and Skerryvore lighthouses, which have withstood the action of heavy seas so successfully.

"*The vertical wall was condemned for many satisfactory reasons; the cost of workmanship, the expensive character of the materials, the liability to destruction if a breach be made, and the unsatisfactory action in consequence of the waves making a clear breach over them in heavy weather.*"

* Report, June 1, 1844; Appendix, No. 1, of the Report of the Commission, p. 73, lines 7 and 8 from near the bottom.

* No. 1, with plates of the plans submitted to the Commission.

The dangerous instability of works executed in deep water, by a system of caissoning, such as that proposed by Mr. Walker, is very generally acknowledged, and is sufficiently proved by the perilous state in which Westminster Bridge now remains, notwithstanding the costly expedients by which it has been attempted to remedy the defects of its original construction. These expedients consist in forming a coffer-dam about each pier, pumping out the water, and then driving rows of sheet piling into the blue clay, so as to form a girdle round the base of the original caisson, thus to prevent the materials of the natural bed of the river from being underwashed by the current, or squeezed out by the weight of the bridge, into the gradually deepening watercourses; but it does seem very strange, that these expedients having failed to arrest the subsidence which is still taking place in Westminster Bridge, the method employed in the construction of that work should be proposed for adoption, on an immense scale, in the formation of a harbour of refuge in Dover Bay.

Article 9.—2. Mr. George Rennie deprecates the upright wall as impracticable and dangerous, and strongly recommends a sloping breakwater, as at Plymouth.

Article 10.—3. Captain Denison is for a vertical wall formed of hexagonal prisms of concrete* (proposed by Monsieur Emy, in 1831, but never adopted), ten feet long, and about 23 tons weight, to be manufactured at Dungeness, and dragged by steam tugs to Dover Bay, by being suspended to rafts formed of two cylindrical pontoons, and there sunk by mechanical means. The wall to be upright from the bottom to about low-water mark, with a superstructure of granite.

Article 11.—4. Sir John Rennie, after deprecating in strong terms all systems of caissoning, and some other expedients, particularly the adoption of upright walls; and after urging the disastrous consequences that may attend any mode of construction which is not recognised as certain of success, proposes the adoption of the principle observed in the breakwater at Plymouth. This he considers as having completely succeeded, and therefore he conceives that it fully justifies the adoption of the like mode of construction for the proposed harbour of refuge in Dover Bay.

Article 12.—5. Colonel Jones† is in favour of a combination, of a sloping breakwater, up to low-water mark, with an upright wall of stone erected on it.

Article 13.—6. Mr. Cubitt, after having been a little taken with the theory of the upright wall (answers to questions 210, 234 to 238, and letter No. 11, Appendix to the Report,) and having since bestowed upon this subject the most careful consideration, comes to the conclusion that any attempt to erect an upright wall in Dover Bay, would be an undertaking of great difficulty, and that the only safe and practical mode of execution is by depositing masses of stone, as shown in the plan which accompanies his Report, to form a sloping breakwater, as at Plymouth, with stone brought from the Channel Islands, or from Portland.

Article 14.—7. Mr. Vignole's plan is to form a sloping breakwater, by depositing cubical blocks of concrete up to about low-water mark, and upon this to erect a vertical wall.

Article 15.—8. Mr. Rendel is next adduced as an advocate for the upright wall. Now, with great respect for the practical opinion of this eminent engineer, it is of importance to review in detail his several examinations before the Harbour of Refuge Commission, previous to his conversion to, or adoption of the new theory, and to advert to the circumstances with respect to material, which induce him now to recommend a wall of that form.

In his examination of the 19th of June, 1844, Mr. Rendel told us, that to construct a breakwater in seven fathoms water, is a very formidable undertaking, especially if caissons or other machines should be resorted to; and that he doubted very much whether if a breakwater is to be constructed in seven fathoms water, the only safe plan would not be, to deposit stones in the usual way from vessels; bringing up the mass to within, say two or three feet of low water; above that, he proposed to construct perpendicular walls, as recommended by Colonel Jones; observing that if stones were deposited in this manner, and allowed to form their own slope, it would, in most situations, be the most economical plan.

He stated that if he had an unlimited command of materials, he would first begin to deposit those materials so as to form a rough mass, and when he had brought his foundations up to that point (nearly low-water mark,) at which the sea would begin to attack him, he would attack the sea, by building with a class of materials that would be its master; adding, that he thought an upright wall in this case might be desirable for a superstructure.

In Mr. Rendel's examination before the

* Captain Denison examined respecting this very ingenious expedient. November 21, 1845, Q. 58 to 115.

† Colonel Jones's letter, June 1, 1844, Appendix, No. 1, to the Report, and plan No. 5. Proceedings of Institute of Civil Engineers, vol. ii., p. 124; and Article 5, p. 6, of this Paper.

Commission, in November, 1845, his attention was expressly called to his former evidence by questions No. 297 to 301, to all of which he replied that he retained the opinions expressed in that evidence; and also stated that he did not know of any instance in which a breakwater with an upright face, of the magnitude now contemplated, had been constructed in the open sea in seven fathoms water. He added, that so far it is an experimental measure. Mr. Rendel's reasons for adopting the upright wall, in the project which he now proposes, are founded purely on considerations of economy in money and time. He observed, that where there is abundance of masses of stone (answer to question 335) fit for constructing breakwaters, he would form them of rubble stone up to low-water mark, with sloping faces, in the manner in which he had just finished a design of Holyhead Harbour; but in order to avoid the expense of bringing stone to Dover, he proposed to adopt, as substitutes for stone, rectangular blocks of brick, set in cement, 10 feet long, five wide, and three thick, and with these to build a perfectly upright wall in Dover Bay, by means of powerful machines and the use of the diving-bell. On a former occasion, Mr. Rendel objected to the employment of machines, and particularly to the use of the diving-bell. This proposition, therefore, resolves itself into the question, whether such a project would be economical.

Mr. Rendel admits that, if the execution of the work by means of brick blocks were pressed on so rapidly as to render it necessary to import into Dover bricks, or materials with which to make them, a great part of the economical advantage would disappear. He also acknowledges "that the advantages of that mode of construction, namely, the upright wall over the common sloping-sided breakwaters, is a mere question of economy in money and time." He has further admitted, that if he had unlimited command of materials at Dover, he would adopt the usual mode hitherto observed in constructing breakwaters. Now Mr. Hartley expressly states, that the expense of providing brick blocks made of the materials that he recommends as indispensable in the construction of such a work, would be greater than that at which granite might be procured from the Channel Islands.

From this and other calculations it appears, that "the mode of constructing breakwaters hitherto observed," with materials of the best description, is preferable, in an economical sense, to that proposed by Mr. Rendel; and this being so, that he would renounce it. We have this reliance on Mr. Rendel's discretion and judgment, that he would guard himself against assuming anything where experience, the only safe guide, can be referred to; and, in a great national work like this, would not propose any new-fangled notions that have nothing but their ingenuity to recommend them.

Article 16.—If then the question, whether the theory of the upright wall, or the established practice of the slope, was to be determined by the opinions of a majority of competitors, the Commission ought to have decided the other way; for, of the eight engineers who gave in plans, four recommended the sloping breakwater; and, of the other four, two propose a combination of the slope below, with a nearly upright superstructure; and only one prefers the upright wall, and this provided his proposition for using brick blocks of 25 tons weight as substitutes for stone, be adopted.

Article 17.—The following is a list of the persons whose opinions are adduced as advising the construction of the upright wall:

1. Professor Airy; 2. Professor Barlow; 3. Major-general Sir J. Burgoyne; 4. Sir Henry de la Beche; 5. Mr. Hartley; 6. Major-general Pasley; 7. Captain Vetch; 8. M. Reibell; 9. Mr. Brunel; 10. Mr. Bremner.

Article 18.—Professor Airy's opinion in matters of science is unquestionably entitled to the very highest respect. I have studied with the greatest attention and profit the Astronomer Royal's tract, in which the phenomena of tides and waves are investigated by a refined analysis on what is called the "wave theory." It is assumed that in deep water, the motions of the particles are oscillatory, and that the rising and falling of the surface of the sea depend on the horizontal movements taking place alternately in the same and in contrary directions; that these displacements are represented by a periodical function (the sine or cosine of an angle depending on time.) The circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth; and the fact that, as the depth of water becomes less, waves become shorter and their fronts steeper, is proved to be in accordance with what may be deduced from the theoretical expressions of the displacements. It follows from this, that, as a sea-wave advances into water gradually becoming shallower, it assumes a crested shape, the upper particles moving towards the coast, till at length the top rolls over the base, the wave breaks, and a surf is created. Reference is made in this article to the special treatises on sea-waves by MM. de la Coudray and Bremontier.

When Mr. Airy was Professor of Natural

Philosophy at Cambridge, he explained, with success, that waves in a fluid at rest, such as we may conceive to arise from throwing a stone into a pond, or the ordinary waves in a close lake, are more or less superficial undulations, and that, in reality, no current, or onward motion of the fluid, appears to take place. I well remember, also, that he invented an ingenious machine by which he illustrated this oscillatory motion. But admitting this to be true, to a considerable extent, in a pond or a small lake, it is totally inapplicable to the sea, the open sea, in Dover Bay, where an immense body of water is in constant motion, by tides rising and falling fifteen or twenty feet in the course of two or three hours, and where the surface is liable to be acted upon by heavy gales, which drive in rolling seas in succession with rapid onward motion, and therefore producing percussive force in the direction of the wind. Without, however, entering here on Professor Airy's theory of waves in the deep open sea, but confining myself to deductions from that theory, as to the practical effect of waves in gales of wind on erections in the sea, of a limited depth; and, referring to the questions 552 to 560, which I ventured to put to the Astronomer Royal, with his answers, it will be seen, that instead of his theory (that the upright wall is in all cases preferable to the slope) being absolute, this eminent authority allows that waves in a breaking or broken state do act percussively and powerfully as hydraulic rams, and not by hydrostatic pressure. How then can that hydraulic action cease, and become merely hydrostatical pressure, unless it has first exerted a force of impact upon the wall which arrests its motion? Even if the wall should stand after having received the shock, the concussion must be more severe on an upright wall, in the ratio above mentioned, than that which would take place on a sloping wall of equal height.

The question of construction, then, resolves itself into this; in what depths of water do waves assume that form and acquire that percussive force? Where, according to this, should the slope cease and the upright wall commence? The professor says, practical opinion, that of the pilots, can best determine this.

Those whom I have questioned on that subject say, that this will be found to take place, in heavy gales of south-west and southerly winds, throughout nearly the whole of Dover Bay at low water.

However this may be, it is clear from the Astronomer Royal's deductions from his own theory, that there should be a sloping breakwater in the shallower parts of the space to be enclosed, and an upright wall in the deeper.

But with respect to the practical question, Professor Airy states, in reply to question 595, whatever theory may say, "that building an unpright wall in the open sea, in seven fathoms water, is so far an experimental measure, that no such work has ever been executed."

With every respect, then, for the theoretical opinion of this high authority, I cannot consider that it would justify the Government in sanctioning the mode of construction recommended by a majority of the Commission; it may rather be inferred that this is contrary to the deductions of science, and that, if the difficulties of constructing such a wall in deep water could be overcome, it would be incapable of resisting the action of the sea where waves assume that shape, and possess that percussive power, which Mr. Airy admits.

Article 19.—Professor Barlow has most usefully applied mathematical investigation to practical purposes, and knows well the difference between theoretical views and practical effects upon a proposition of this description. In his letter of the 5th January, 1846, written in reply to the question referred to him, he states, that theory cannot safely settle that question; he avows that he has not sufficient practical knowledge or experience to enable him to speak confidently on the subject; expresses himself diffidently, cautiously, and even ambiguously, as to the theory; and recommends that the question be referred to practical men for their opinion, made upon results obtained from actual experience and observation. The learned professor therefore rather declined and disclaimed giving a decided opinion in favour of the upright wall; and I think he will be surprised to find that his letter has been adduced, by a majority of the Commission, rather as conflicting with, than as deferring to the opinion of practical men. Further it appears, by the professor's letter, that he is decidedly opposed to the theory of the upright wall; for he denies the assumption on which it is based; namely, "that waves have no onward motion." He states, "there can be no doubt that waves, when acted upon by tempestuous winds, will beat with great violence against any obstacle opposed to their progress; that what we want in breakwaters is, to resist that force; to withstand that momentum; and that much of this direct violence would be avoided by receiving that action on an inclined surface."

Article 20.—3. I refer with the greatest deference and respect to any practical

opinion of so eminent a man as Major-General Sir John Burgoyne; but I do not read his letter on the comparative merits and capabilities of the upright wall and the slope, as containing any very positive or confident preference of the former; and in that letter it is admitted that there can be no doubt as to the security of the slope. This distinguished military engineer says:

"The effort against the upright wall I conceive would be far less.

"In deep water, the action of the wave is, I apprehend, an up and down undulation, the water having very little, if any, forward motion, except where it breaks. A flat piece of wood, floating on the surface, and presenting no hold to the wind, would progress very slowly before the heaviest gale; therefore I consider that there would be no blow or impulse generally on the upright wall, but merely the weight of water from the top of the wave to its mean level, to be supported.

"I should not expect that the wall itself would cause the waves to break, and even those that accidentally did so at that particular place would have much of their force caught by the receding of the previous wave, so as rarely to strike with much force against the wall itself.

"There can be no doubt but that a slope could be given to a breakwater that would be very secure.

"In Hollond, the shores, even of sand, are in many parts secured against the whole force of the North Sea by a surface coating of mere clay and straw, but then the inclination is exceedingly gentle quite to deep water, not more, I apprehend, than 1 in 18 or 1 in 24. As the material is increased in size and weight, it is to be presumed that this slope may be increased."

Article 21.—4. Sir Henry De la Beche is adduced as an advocate for the upright wall. Now the theory of the upright wall rests entirely upon the assumption that waves have no progressive forward movement or motion, or percussive force, in acting upon erections in the sea, or on coasts, cliffs, or beaches. But Sir H. De la Beche expressly states, that seas in heavy gales of wind are urged onwards in the direction of the winds which raise them; that waves in a breaking state possess enormous force from the weight and velocity of the water thrown forward; and the following extracts from his very able work, "How to Observe Geology," show that he has been erroneously cited, or that he expressed himself in an unguarded manner, when he asserted that upright walls resembling cliffs are more capable of resisting the percussive effects of waves and seas than slopes.

In the very able work which this eminent geologist published,* he delivers (page 53) the following rules as the result of what he had observed and ascertained with respect to the action of the sea:

"Properly to estimate the effects of this power, the observer should be present on some exposed coast, such as that of the western part of Ireland, the Land's End, Cornwall, or among the western islands of Scotland, during a heavy gale from the westward, and mark the crash of a heavy Atlantic wave when it strikes the coast. The blow is sometimes so heavy that the rock will seem to tremble beneath his feet. He will generally find in such situations, that though the rocks are scooped and caverned into a thousand fantastic shapes, they are still hard rocks, for no others could continue long to resist the almost incessant action of such an abrading force. Having witnessed such a scene, he will be better able to appreciate the effects, even though the waves be far inferior in size, upon the softer rocks of other coasts.

"The observer should carefully remark the direction of the prevalent winds, and the proportion of those which send the greatest waves, or seas as they are termed, on shore, in order that he may duly appreciate the loss of coast sustained in those directions where the force of the breakers is greatest and most incessant.

"It must not, however, be forgotten that coasts where breakers reach the cliffs at high water, are frequently protected by beaches at low water; and that therefore they are removed from the abrading power of the waves, during all the time that they break on the protecting beaches, a time which varies with the varying state of the tides, and the state of the weather generally.

"Other encroachments are made by the fall of masses of cliff undermined by the waves, the cohesive power of the rock not being equal to its weight, or the action of gravity downwards. If a rock be even sufficiently cohesive in the mass, as to admit of considerable excavation without falling, a time must come, if the breakers continue to work on in the same direction, when the weight of the superincumbent mass would be such that it must fall.

"Where, however, a great mass of cliff does fall, in the manner noticed above, the observer should direct his attention to its conservative influence. To appreciate this he will consider the hardness of the rock, the position into which it has fallen, and its new power of breaking the waves farther

* How to Observe Geology. London, 1835.

from the coast. If the mass of fallen rock be stratified, much will depend upon the face presented to the breakers; for if it fall so that the plane of the beds remains sloping seaward, it will act as a well-contrived wall erected to defend the cliff; but if the beds should be exposed vertically after the fall, the future destruction of the mass would be far more rapid, and its conservative influence consequently less."

Now this testimony is better founded and much safer as a practical guide, than that which this distinguished geologist gave, I think conversationally, in answer to Question 205, November, 21st, 1845, where he speaks of the "flop and comparatively small action of the sea," on vertical cliffs; and I appeal to that passage in his work in which he speaks of "the crash of a wave when it strikes a cliff as giving so heavy a blow that the rocks seem to tremble beneath his feet." Mr. Lyell makes a remarkable statement respecting Sheringham, on the coast of Norfolk: "I ascertained in 1829, some facts which throw light upon the rate at which the sea gains on the land. It was computed, when the present inn was built, in 1805, that it would require 70 years for the sea to reach the spot, the mean loss of land being calculated, from previous observations, to be somewhat less than one yard annually. The distance between the house and the sea was 50 yards; but no allowance was made for the slope of the ground being from the sea, in consequence of which the waste was naturally accelerated every year, as the cliff grew lower, there being, at every succeeding period, less matter to remove when portions of equal area fell down. Between the years 1824 and 1829 no less than 17 yards were swept away, and only a small garden was then left between the building and the sea. There is now a depth of 20 feet, sufficient to float a frigate, at one point, in the harbour of the port, where only 48 years ago there stood a cliff 50 feet high. If once in half a century an equal amount of change were produced at once by the momentary shock of an earthquake, history would be filled with records of such wonderful revolutions of the earth's surface; but if the conversion of high land into deep sea be gradual, it excites only local attention."

Article 22.—5. No one knows better than I do the ability, the zeal, and the intelligence which Mr. Hartley has displayed in his construction of the Liverpool Docks, and the hydraulic works in the River Mersey; in stating his evidence, as that of a practical man, in favour of the upright wall in the open sea in Dover Bay, I think it best to let him speak for himself.

Question. "You say you prefer an upright wall to any other form for a breakwater; do you know any certain instance of the positive experiment of a wall which has stood the test of time in such an exposed situation, and on such a monstrous scale as Dover Harbour may require?—*Answer.* I do not.

"Is it merely matter of opinion?—That is all.

"This perfectly upright wall in Dover Bay in seven fathoms water is an experimental measure you admit?—Quite so as respects myself.

"With respect to the time that it would take to make a breakwater, is that opinion formed upon any knowledge of Dover, or the difficulties of making a wall at Dover?—No, it is only founded upon a supposition of what the sea is in general, and supposing I was to attend to it myself, and had nothing else to do; but it is a vague sort of idea.

"You are not acquainted with the locality?—No, not sufficiently; I have been there two or three times.

"Have you ever built a wall yourself in such deep water as that?—No, never."

(*To be continued.*)

ON THE PROCESS OF SYNTHETIC DIVISION.

Sir,—Allow me, through the medium of your Journal, to call the attention of mathematicians to the following extract from the *Cours Complet de Mathématiques Pures*, par L. B. Fraucœur, second edition. Paris: 1819.

Extract.

Art 500, page 36, vol. 2.—"Après avoir transposé, réduit et divisé par le coefficient de la plus haute puissance de x, toute equation à la forme $x^m + px^{m-1} + qx^{m-2} \ldots\ldots tx + u = 0$, que nous représenterons, pour abréger, par $X = 0$; $p, q, \ldots\ldots u$, sont des nombres positifs, négatifs, ou zéro. On nomme racine toute quantité (a) qui, substituée à x, reduit X à zéro, ou donne $a^m + pa^{m-1} + qa^{m-2} \ldots\ldots + u = 0$. Soit (a) une quantité prise au hasard, divisions par $x - a$ le polynome proposé X. On a démontré, p. 132 du 1er vol., que si l'on pousse le calcul jusqu' à ce que x n'entre plus dans le dividende, on arrive au reste $a^m + pa^{m-1} + qa^{m-2} \ldots\ldots u$; expression qui est nulle si (a) est racine, et qui n'est pas nulle si (a) n'est pas racine. Donc X est ou n'est pas divisible par $x - a$, selon que (a) est ou n'est pas racine de l'equation $X = 0$.

En outre, on a vu que les coefficiens du quotient sont de la forme $a^m + pa^{m-1} + qa^{m-2} \ldots\ldots + sa^0$; en sorte que chacun se

déduit du précédent en le multipliant par (a), et ajoutant au produit le coefficient s du terme qui, dans X, a la même puissance de x. Donc *pour diviser*, par exemple,

$$x^5-5x^4+7x^3-4x^2-x+13 \text{ par } x-2.$$

$a=2$. $+1-3+1-2-5$; reste $+3$, je pose le coefficient 1 de x^5 sous -5; je multiplie 1 par 2, valeur de (a), et j'ajoute -5; $1\times2-5=-3$ que j'écris sous $+7$; de même $-3\times2+7=+1$, que je pose sous -4; $1\times2-4=-2$, etc...... *Les nombres de la 2ᵉ ligne sont les coefficiens du quotient* $x^4-3x^3+x^2-2x-5$, le reste est $+3$. Voici un autre exemple de ce calcul où la division réussit:

$$4x^5+6x^4-8x^3-6x^2+5x+2 \text{ par } x+2.$$

$a=-2$, $+4-2-4+2+1$; reste zéro."

In the subsequent edition of the "Cours" the "process" is demonstrated and applied to the transformation of equations almost exactly in Horner's manner, as in the following example, where y is assumed $=x-3$.

Proposed equation—

$$2x^4-7x^3-12x^2+4x+129=0.$$

$$\text{Factor 3.}\begin{cases}2 & -1 & -15 & -41 & +\ \ 6\\ 2 & +5 & +\ \ 0 & -41 & \\ 2 & +11 & +\ 33 & & \\ 2 & +17 & & & \end{cases}$$

Transformed equation $2y^4+17y^3+33y^2-41y+6=0$."—*Blacklock's Translation*, pp. 33—4, also pp. 37—8. Cambridge, 1830.

My object in proposing the above for consideration is to ascertain whether Francoeur's claim to the discovery of the process of "Synthetic Division" is not *prior* to that of Horner; seeing that the method appears to be incidentally given by Francoeur in 1819, and Horner did not *privately* make known his discovery until June, 1821, nor *publicly* until 1827. See "Davies's Solutions to Hutton's Course," p. 94.

I am, Sir, yours, &c.,

THOS. WILKINSON.

Burnley, Lancashire, June 5, 1848.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Henry Adcock, of Moorgate-street, London, civil engineer, for certain improvements in furnaces and fire-places. June 8; six months.

William Brindley, of Birmingham, manufacturer, for improvements in the manufacture of articles of papier-mache. June 6; six months.

Richard Barnes, of Wigan, Lancaster, gas engineer, for certain improved apparatus for manufacturing gas for illumination, part of which improvements is applicable to retorts for distilling pyroligneous acid and other similar purposes. June 6; six months.

Benjamin Lathrop, of King-street, Cheapside, Esq., for an improved wheel for railway purposes. (Being partly a communication.) June 8; six months.

Joseph Foot, of Spital-square, Middlesex, silk manufacturer, for improvements in marking skeins of silk. (Being a communication.) June 8; six months.

Joshua Procter Westhead, of Manchester, manufacturing fur into fabrics. (Being a communication.) June 8; six months.

Thomas Dalton, of Coventry, silk dyer, for improvements in the manufacture of fringes, gimps, and bullions. June 8; six months.

Alexander Paul Maril Darlin, of Paris, France, gentleman, for improvements in obtaining motive power. June 8; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
June 3	1464	Rock and Son	Hastings	Carriage head.
„	1465	William Southam	Nuneaton, Warwickshire	Pneumatic flour dresser.
„	1466	John Eaton	Woodford, near Thrapston, Northamptonshire	Tipping cast.
6	1467	William Bonser	Kinolton, Nottinghamshire	A drain pipe.
7	1468	Ephraim Ferdinand Wollheim	Paris	Comb tooth cleaner.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1297.] **SATURDAY JUNE 17, 1848.** **[Price 3*d*., Stamped 4*d*.**

Edited by J. C. Robertson, 166, Fleet-street.

LORD WILLOUGHBY DE ERESBY'S IMPROVED PEAT-COMPRESSING MACHINE.

Fig. 2.

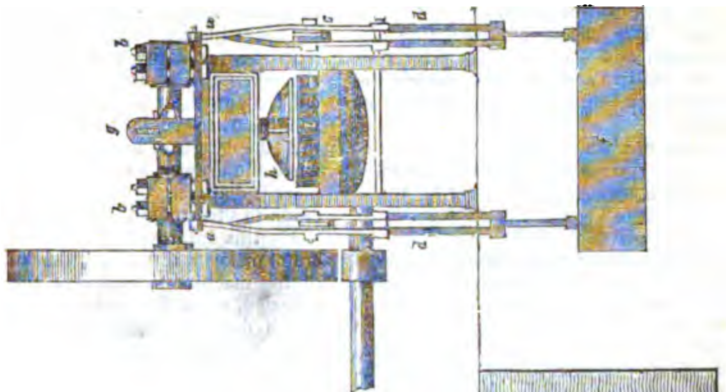
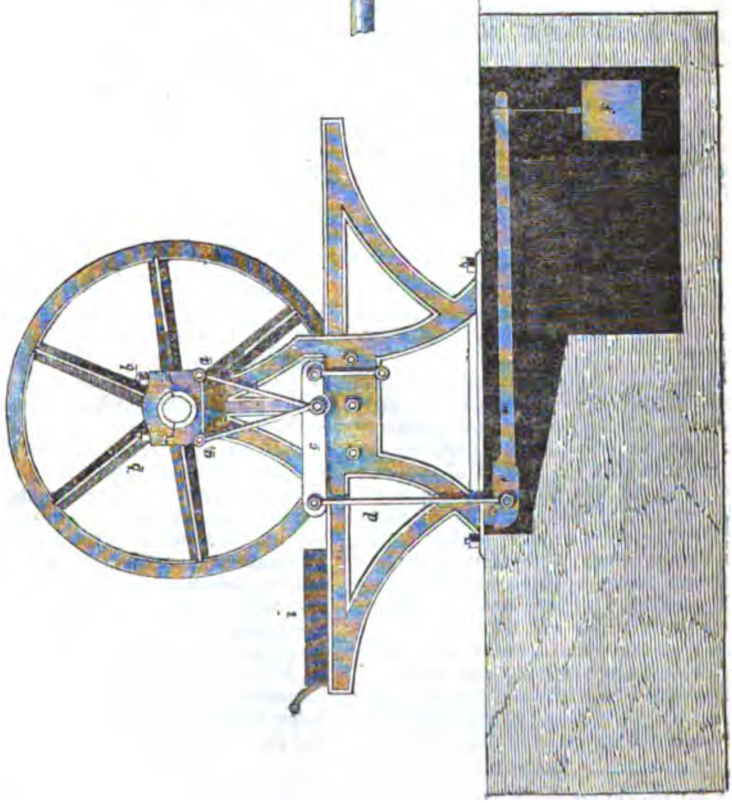


Fig. 1.



LORD WILLOUGHBY DE ERESBY'S IMPROVED PEAT-COMPRESSING MACHINE.

Sir,—Having improved my machinery for the compression of peat,* I take the liberty of inclosing a drawing and description of it in its present state. The advantages obtained are,

1st. Uniform pressure.

2nd. The means of regulating the pressure; and

3rd. Security from the danger of breaking the machinery or impeding its action:

I am, Sir, yours, &c.,

WILLOUGHBY DE ERESBY.

142, Piccadilly, June 15, 1848.

Description.

Fig. 1 is an elevation of my improved crank machine, as at work compressing peat on one of my estates in Scotland; and fig. 2 is an elevation of it. The links, *a a*, are connected with the bolts, *b b*, of the plummer-block of the crank-shaft at the one end, and with the lever, *c*, at the other. The lever, *c*, is connected by the rod, *d*, with the under lever, *e*, and at the extreme end of this lever a weight, *f*, is suspended, to keep the crank-shaft down. A similar arrangement of levers is on the other side of the machine, as shown by fig. 2. The weight, *f*, is attached to both sets of levers in a pit under the machine.

When the crank, *g*, (fig. 2,) is turned round, and the piston, *h*, brought in contact with the peat, the crank-shaft will be forced upwards; and the top of the plummer-blocks, which are connected with the levers by the links, *a a*, will rise when the pressure exceeds the calculated power, or 36 tons, supposing the weight, *f*, to be only half a ton; and thus the danger of breaking the machine, when the drawer, *r*, in which the peat is placed, happens to be too full for the crank to turn round, is avoided.

By this improvement, each time the crank makes a revolution, the full power of the machine to compress the peat is repeated, until the levers cease to rise, which does not happen before the peat has received great density, or rather, before a large quantity of the water which it contains has been expelled from it through the filtering bottom of the drawer, *i*, and also by the filtering channels in the surface of the piston, *n*, as was fully explained on a former occasion in the columns of your valuable Magazine.

ON THE MOTION OF WAVES.

In Mahan's "Civil Engineering" (p. 134 of the English edition, edited by Professor Barlow,) the following observations are made:

"A good theory of waves, which shall satisfactorily explain all their phenomena, is still a desideratum in science. It is known that they are produced by winds acting on the surface of the sea; but how far this action extends below the surface, and what are its effects at various depths, are questions that remain to be answered. The most commonly received theory is, that a wave is a simple oscillation of the water, in which each particle rises and falls in a vertical line a certain distance during each oscillation, without receiving any motion of translation in a horizontal direction; and that the effects caused by this oscillation are only felt within its limits, or between the highest and lowest points of the wave; or, if felt beneath the surface of the water, they are only so at very inconsiderable depths. The objection to this theory is, that it does not explain many phenomena which are observed in connection with waves.

"In a recent French work on the subject, its author, Colonel Emy, an engineer of high standing, combats the received theory, and contends that the particles of water receive also a motion of translation horizontally, which, with that of ascension, cause the particles to assume an orbicular motion, each particle describing an orbit which he supposes to be elliptical. He farther contends, that in this manner the particles at the surface communicate their motion to those just below them, and these again to the next, and so on downwards, the intensity de-

* For previous descriptions of this machinery, see *Mech. Mag.*, vol. xxvii., p. 193, and vol. xxvi., p. 449.—ED. M. M.

creasing from the surface, without, however, becoming insensible at even very considerable depths; and that in this way, owing to the reaction from the bottom, an immense volume of water is propelled along the bottom itself, with a motion of translation so powerful as to overthrow obstacles of the greatest strength, if directly opposed to it. From this he argues, that walls built to resist the shock of the waves should receive a very great batter at the base, and that this batter should be gradually increased upwards until, towards the top, the wall should project over, thus presenting a concave surface to throw the water back. By adopting this form, he contends that the mass of water which is rolled forward, as it were, on the bottom, when it strikes the face of the wall, will ascend along it, and thus gradually lose its momentum; but how far these views are correct, remains to be determined. It appears, from experiments made by the author in question upon walls of the form here described, that they fully answered their intended purpose."

This was written in 1837, and Colonel Emy's work must, of course, be of still earlier date. In the "Cambridge Philosophical Transactions" for 1837 and 1839 there are two papers, by Mr. Green, on this subject of waves; in the second of which the circular motion of each particle of water is deduced from the general equations of fluid motion, on the supposition of an unlimited depth of water; and as the investigation is short, and may be interesting to some readers of the Magazine, I shall here give it:

"The theory of the motion of waves in a deep sea, taking the most simple case, in which the oscillations follow the law of the cycloidal pendulum, and considering the depth as infinite, is extremely easy, and may be thus exhibited:

"Take the plane (xz) perpendicular to the ridge of one of the waves supposed to extend indefinitely in the direction of the axis (y), and let the velocities of the fluid particles be independent of the coordinate y. Then if we conceive the axis (z) to be directed vertically downwards, and the plane (xy) to coincide with the surface of the sea in equilibrium, we have generally

$$gz-\frac{p}{\rho}=\frac{d\phi}{dt}.$$

$$\frac{d^2\phi}{dx^2}+\frac{d^2\phi}{dz^2}=0.$$

The condition due to the upper surface, found as before, is

$$g.\frac{d\phi}{dz}-\frac{d^2\phi}{dt^2}=0.$$

From what precedes, it will be clear that we have now only to satisfy the second of the general equations, in conjunction with the condition just given. This may be effected most conveniently by taking

$$\phi=\text{H}.\varepsilon^{-\frac{2\pi}{\lambda}.z}.\sin\frac{2\pi}{\lambda}(vt-x).$$

by which the general equation is immediately satisfied, and the condition due to the surface gives

$$g=\frac{2\pi}{\lambda}v^2;\text{ or }v=\sqrt{\frac{g\lambda}{2\pi}}:$$

where λ is evidently the length of a wave.

"Hence the velocity of these waves vary as $\sqrt{\lambda}$, agreeably to what Newton asserts. But the value assigned by the correct theory exceeds Newton's value in the ratio of $\sqrt{\pi}$ to $\sqrt{2}$, or of 5 to 4 nearly.

"What immediately precedes is not given as new, but merely on account of the extreme simplicity of the analysis employed. We shall, moreover, be able thence to deduce a singular consequence, which has not been before noticed, that I am aware of.

"Let a, b, c, be the co-ordinates of any particle P of the fluid when in equilibrium. Then since

$$\phi=\text{H}.\varepsilon^{-\frac{2\pi}{\lambda}.z}.\sin\frac{2\pi}{\lambda}(vt-x).$$

$$\Phi=-\frac{\text{H}.\lambda}{2\pi v}.\varepsilon^{-\frac{2\pi}{\lambda}c}.\cos\frac{2\pi}{\lambda}.(vt-a).$$

And the general formulæ (2) give

$$x=a+\frac{d\Phi}{da}=a-\frac{\text{H}}{v}.\varepsilon^{-\frac{2\pi}{\lambda}c}.\sin\frac{2\pi}{\lambda}(vt-a).$$

$$z=c+\frac{d\Phi}{dc}=c+\frac{\mathrm{H}}{v}.\epsilon^{-\frac{2\pi}{\lambda}c.}\cos\frac{2\pi}{\lambda}(vt-a).$$

$$\text{Hence } (x-a)^2+(z-c)^2=\left(\frac{\mathrm{H}}{v}.\epsilon^{-\frac{2\pi c}{\lambda}}\right)^2$$

And therefore any particle P revolves continually in a circular orbit of which the radius is

$$\frac{\mathrm{H}}{v}\epsilon^{-\frac{2\pi c}{\lambda}}$$

round the point which it would occupy in a state of equilibrium. The radius of this circle, and consequently the agitation of the fluid particles, decreases very rapidly as the depth (c) increases, and much more rapidly for short than long waves, agreeable to observation. Moreover, the direction of the rotation is such, that in the upper part of the circle the point P moves in the direction of the motion of the wave. Hence, as in the propagation of the great primary wave, the actual motion of the fluid particles is direct where the surface of the fluid rises above that of equilibrium, and retrograde in the contrary case."

There are some steps in the preceding investigation which require supplying.

1st. The condition due to the upper surface. The condition that the particles which at any time are on the surface, continue always to form part of the same surface, gives the following equation,

$$\frac{df}{dt}+u.\frac{df}{dx}+v.\frac{df}{dy}+w.\frac{df}{dz}=0\,;$$

(See Poisson, "Traité de Mecanique," tome ii. art. 652), $f(t, x, y, z,)=0$ being the equation to the surface, and

$$u=\frac{d\phi}{dx},\, v=\frac{d\phi}{dy},\, w=\frac{d\phi}{dz},$$

being the velocities parallel to the co-ordinate axes. In the present case, let $z=c+\zeta$ be the equation to the surface of the water, c being the depth when undisturbed, and ζ the elevation or depression, which is here considered a function of x and t only.

The preceding equation becomes therefore,

$$\frac{d\phi}{dz}-\frac{d\zeta}{dt}-\frac{d\zeta}{dx}.\frac{d\phi}{dx}=0\,;$$

or neglecting the last term as being the product of two small fractions,

$$\frac{d\phi}{dz}-\frac{d\zeta}{dt}=0.$$

Also at the upper surface the pressure $(p)=0$, so that the first of the general equations gives

$$g(c+\zeta)=\frac{d\phi}{dt}.\text{ or }\frac{d\zeta}{dt}=\frac{1}{g}.\frac{d^2\phi}{dt^2}.$$

eliminate ζ between the two last equations; and we have the equation in question, viz.,

$$g.\frac{d\phi}{dz}-\frac{d^2\phi}{dt^2}=0.$$

2nd. The formulæ $x=a+\frac{d\Phi}{da}$, &c., are taken from Lagrange, "Mécanique Analytique," tome ii., p. 313, where they are obtained on the supposition that the velocities parallel to the co-ordinate axes are extremely small—which is, indeed, an essential condition throughout the whole investigation.

On the same hypothesis, namely, that the motion is of an oscillatory kind and of small extent, Professor Airy has arrived at similar results in his treatise on "Tides and Waves," in the *Encyclopædia Metropolitana*. In addition, he has shown that when the length of the wave is great in proportion to the depth of the water, the motion becomes elliptical instead of circular. Any one who has watched a piece of floating wood from the sea-shore, must have observed that its motion—and consequently that of the surrounding particles of water which it indicates—is of this nature, *i. e.* is not merely vertical, but that as the wave rises under it, it is carried forwards and backwards again in the hollow of the wave. But near the sea-shore the conditions are different from those contemplated in the preceding mathematical calculations, inasmuch as the bed of the sea is here sloping and rapidly becoming nearer to the surface of the water.

With reference to this case, Professor Airy has entered into some reasoning which appears to be of a doubtful and

unsatisfactory nature. It occurs in Arts. 155, 156, 157, and 158, under the title of "Investigation of the possibility of unbroken Waves when the depth is variable." Two equations are to be satisfied—one, that of continuity, and the other depending on the force of gravity, from combining which, the equation $\frac{d^2X}{dx^2}+\frac{d^2X}{dy^2}=0$, is deduced the general solution of which is

$$X=\phi(y+x\sqrt{-1})+\psi(y-x\sqrt{-1}).$$

(X is the horizontal displacement of a particle).

Professor Airy proceeds thus:

"If instead of ϕ and ψ we use two other functions, χ and ω, we may put the solution under this form

$$X=\chi(y+x\sqrt{-1})+\chi(y-x\sqrt{-1})+\frac{1}{\sqrt{-1}}\left\{\omega(y+x\sqrt{-1})-\omega(y-x\sqrt{-1})\right\}$$

the whole of which is real, whatever be the form of the functions χ and ω, provided that they contain in their form nothing imaginary."

It is evident that this goes no way towards determining the question.

The transformation is effected by a reference to the initial circumstances of the motion—or rather by finding what X and its differential coefficients are when x or $y=0$. If the bottom of the sea or river, instead of being of any regular form, present sudden and abrupt inequalities of surface, (η) will be a *discontinuous* functions of x, and the solution "becomes nugatory," as Poisson has remarked with regard to this very equation in his "Theorié Mathématique de la Chaleur." (Page 172).

"Si par example, l'équation d'un probleme est

$$\frac{d^2u}{dt^2}+\frac{d^2u}{dx^2}=0.$$

son integrale complete sera

$$u+f(x+t\sqrt{-1})+F(x-t\sqrt{-1}).$$

f et F designant deux fonctions arbitraires, dont on determinera les valeurs d'àpres celles de u et $\frac{du}{dt}$ qui repondent à $t=0$. Les fonctions $f(x)$ et $F(x)$ seront alors des quantitées reelles pour toutes les valeurs de x qui repondent à des points du système. Si elles sont continues et qu'on en ait l'expression analytique, les imaginaires disparaitront de la formule precedente; mais si elles sont discontinues, ce qui a lieu dans la plupart des problemes, on n'en pourra pas conclure les valeurs de $f(x-t\sqrt{-1})$ et $F(x-t\sqrt{-1})$ et la solution precedente deviendra illusoire."

The equation of continuity really expresses the condition, or, more properly, the consequence, of there being no *new* and *disturbing* forces introduced during the instant under consideration. Now the abrupt inequalities of the bottom in shallow water *do* introduce such new and disturbing forces, and consequently a breach in the continuity and broken water.

Mr. Airy, however, instead of these considerations, which appear to be the true statement of the connection between the *physical* discontinuity and its mathematical expression, proceeds to account for it as follows:

"But the expression just found is the solution of the derived equation. We have now to ascertain whether it will satisfy the *original* equations." The result of this substitution gives according to him, two equations to be satisfied, the first of which is,

$$\frac{d^2}{dx^2}\left\{v(\eta+x\sqrt{-1})+v(\eta-x\sqrt{-1})\right\}=0,$$

from which he concludes as follows:

"When the depth is variable, that is, when η is a function of x, it does not appear possible to satisfy this equation by any form of v. It would appear therefore, that when the depth is variable, it is impossible that there can be a series of waves which consist of oscillatory motions of the particles, and which satisfy the two equations of continuity and equal pressure.

"The following physical interpretation of this mathematical result appears to be correct, and is worthy of attention. It appears that if the water is moving in the manner of waves, one at least of the two conditions (continuity and equal pressure) must fail. While the continuity holds, the equal pressure will exist from the nature of the fluid. There-

fore the continuity must cease, or the water must become *broken*. This appears to be the explanation of the broken water which is usually seen upon the edge of a shoal or ledge or rocks, although the whole is covered, perhaps deeply, by the water."

The assertion that "it does not appear possible to satisfy the equation by any form of v" is certainly a very singular one. The following solutions occur immediately:

1st. Let the bed of the river or sea be an inclined plane, or $\eta = mx + c$; and suppose $v(\eta + x\sqrt{-1})$ to be $\eta + x\sqrt{-1}$.; then the equation is satisfied, since

$$\frac{d^2}{dx^2}\left(mx + c\right) = 0.$$

2nd. Let $\eta^2 - x^2 = mx$, or $\eta^2 = a^2 + x^2$, and suppose $v(\eta + x\sqrt{-1})$ to be $(\eta + x\sqrt{-1})^2$ Either of these conditions satisfy it.

Or, generally, let

$$v(\eta + x\sqrt{-1}) + v(\eta - x\sqrt{-1})$$

be

$$(\eta + x\sqrt{-1})^n + (\eta - x\sqrt{-})^n.$$

Then the assertion is equivalent to saying that it is impossible by any relation between η and x to make the second differential coefficient with regard to x, of the following expression, vanish.

$$2\left[\eta^n - \frac{n(n-1)}{1.2}\eta^{n-2}x^2 + \frac{n(n-1)(n-2)(n-3)}{1.2.3.4}\eta^{n-4}x^4 - \&c.\right]$$

At least, if Professor Airy does not mean this, what does he mean? There is no other interpretation that I can see. It does not appear possible to make English of his expression by any other. With regard to the practical question as to the best form of breakwater, experiment seems to be the only safe guide. Professor Airy, in his Report, refers to some theoretical investigation of his own, on the subject, as corroborating his views about the superiority of vertical walls. Where these theoretical investigations are to be found, I know not: I have, at least, found nothing to the purpose in his article on "Tides and Waves" above mentioned. The whole subject of the motion of fluids is yet in a most unsatisfactory state, and I think few that have looked into this recent production of the Astronomer Royal, will consider that any great advance is made in it towards such an end. It is not a long array of mathematical formulæ that we want, but clearer notions to begin with. And here it may be proper to repeat that the preceding extracts have been given chiefly as subjects of interest to the mathematical readers of this Magazine, and not with any idea of their being of much use to the practical man;—the only fact mentioned, viz., the circular or elliptical motion of the particles, being one familiar, probably, to most persons from actual observation.

A. H.

WADHAM'S ELECTRICAL CLOCK.

Sir,—In reply to your correspondent, Mr. Hislop, I beg to say, that the electrical clock referred to in my former note, has a detached escapement, and its isochronism is not affected by the greater or less amount of spring wound up by the rachet-wheel.

The latter performs the same office as an ordinary *watch-key* in the act of rewinding a watch—the difference being that, instead of this operation being performed every day, or every eight days, as in ordinary watches or clocks, it is in progress from moment to moment, *i. e.*, the electro-galvanic agency is continually employed in winding up the main spring of the clock.

By "accumulating" the power, it was intended to express the fact, that if the clock be in the first instance started by only *partially* winding up the main spring, the clock will not only be *maintained* in action by the electro-galvanic arrangement, but the spring will be found in a short time *fully wound up*, and it would soon be overwound and injured if provision were not made to meet this exigency; it is done thus:—The outer end of the spring is *not fastened* to the inside of the barrel containing it. It has sufficient hold on it by friction to be the moving power of the train of wheels; but as soon as it is fully wound up, it slides (or rather *can* slide, if the strength of the battery power renders it necessary) on the inner surface of the barrel, and so can never, *in fact*, be overwound.

The object of arranging this *winding-*

up power so as to be a little in advance of what is merely *required* for the service of the clock, is to provide for and render harmless any failure of metallic contact which now and then may occur from a particle of dust interposing at the point where the battery contact is made and broken. It also provides a small store (or "*accumulation*") of power, which serves to keep the clock in action for a minute or two independently of the battery current, and so admits of the removal of an exhausted, and the substitution of a fresh battery, without arresting the movement of the clock.

The clock is of course regulated by a spiral spring attached to the axis of the balance-wheel, and it is most satisfactory in its action.

I regret the pressure of other matters prevents my giving you any more detailed description of this interesting piece of electro-magnetic mechanism.

I am, Sir, yours, &c.

F. L.

Bath, June 5, 1848.

MATHEMATICAL PERIODICALS.

(Continued from page 514.)

VII. *The Quarterly Visitor.*

Origin.—This periodical was commenced at Hull "on the earnest solicitations" of the friends of the editor, who "having always been interested in scientific pursuits, and anxious for the dissemination of useful learning, entered upon the undertaking with cheerfulness and avidity." The first number appeared in 1813, and "*time*, which puts an end to all human pleasures and sorrows, concluded the labours of the *Editor* of the *Quarterly Visitor*," with No. VI., vol. ii., in December, 1815.

Editor.—Mr. Wm. Passman, Teacher of Mathematics, &c., Hull, Yorkshire.

Contents.—The contents of the work consist of Memoirs of Eminent Men, Miscellaneous Pieces in prose and verse, Latin Extracts, &c., for Translation, Essays on Various Subjects, Grammatical and Philosophical Queries, Reviews of Books on Science and Education, Mathematical Problems, &c., "selected from the contributions of men of eminence in most parts of the kingdom." Among the memoirs may be mentioned those of Horsley, Maskelyne, and Ritson; the essays contain some useful remarks on paper money and gold, the corn laws, apparitions, antiquity, &c., of music, and the well-known and excellent one by the editor on the "Utility of Mathematical Learning." In the Reviews are notices of Youle's Arithmetic and Bonnycastle's Algebra, 2 vols., 8vo.

Questions.—The total number of mathematical questions proposed and answered is 135, which belong principally to algebra and its applications. The editor appears not to have succeeded in exhibiting a mathematical department equal to that of similar works of the same date; partly, perhaps, from want of taste, and partly "lest those unacquainted with his favourite pursuits, should raise a clamour against him, and propagate the idea that the work was purely mathematical." Some of the best questions in the collection were furnished by the well-known and able geometer, Mr. John Whitley.

Contributors.—Among the contributors to the work may be mentioned Baines, Burdon, John Darby, of Leeds, author of a "Key to Bland's Problems," and Treatises on Algebra and Arithmetic; England, Gawthorp, Glendenning, Hine, Lamplugh, Leng, Maffett, Ryley, Waterland, Watson, Whitley, Winward, Wiseman, Youle, &c.

Publication.—The work was published in quarterly numbers, as its title implies; it was printed for the proprietors by Robert Peck, of the *Packet Office*, Hull, and was sold by Longman, Hurst, Rees, Orme, and Brown, London.

THOS. WILKINSON.

Burnley, Lancashire, June 10, 1848.

*** *Erratum.*—In p. 467, col. 1, line 13, *for* Ray *read* Kay.

ON THE PROCESS OF SYNTHETIC DIVISION.

Sir,—Your ingenious and able correspondent, Mr. Thos. Wilkinson, has been anticipated in the remark which is the object of his communication to you in the last number of the *Mechanics' Magazine*. In allusion to the method of division employed by Mr. Horner, you will find the following observation at page 47 of the second edition of my book on Equations, viz., "It is distinctly enough stated by Garnier, in his *Elemens d'Algèbre*, 1811, p. 399; and still more so by Francœur, in his *Mathématiques*, 1819, tom. ii., p. 37; but its practical bearing upon

the solution of equations was not observed till the publication of Mr. Horner's Researches." I think, too, that Mr. Horner gave the name of "Synthetic Division" to a *general* process, of which the particular instance referred to—if, indeed, an instance it be—is only the simplest case.

I am, Sir, yours, &c.,

J. R. YOUNG.

Belfast, June 12, 1848.

STILL'S GAS PURIFIER.

[Registered under the Act for the Protection of Articles of Utility. Alfred Henry Still, of the Gas Light and Coke Company's Works, Curtain-road, Shoreditch, Proprietor.]

Fig. 1.

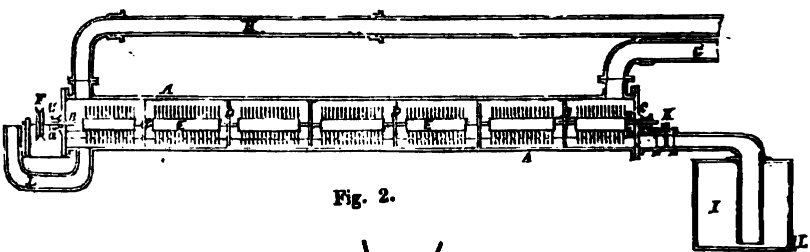


Fig. 2.

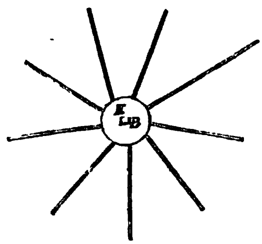


Fig. 1 is a longitudinal section of this purifier. A A is a cylindrical case, and B a shaft, which runs the whole length of the cylinder, A; it has its bearings in stuffing-boxes which are placed around it, where it passes through the ends, C C, of the cylinder, and also in the upright bars, D, D, D. E, E, E are a set of wooden rollers, affixed on the shaft, B; they are studded with strips of whalebone, or other flexible material, throughout their whole length. A cross section of one of them is given in fig. 2. The cylinder, A, is filled to the height of the line *a b* with water, or a mixture of lime and water, or any other suitable liquid or solution; the shaft, B, is made to rotate by means of a band from some prime moving power passed over the pulley, F. The gas to be purified is then allowed to escape through the pipe, G, and after passing through the machine, it escapes by the pipe, H. When a fresh supply of water, or lime and water, is required, the previous or exhausted charge is allowed to flow into the vessel, I, by means of the valve, K, from which vessel it can be subsequently removed through the door, L. The fresh material is supplied to the cylinder through the pipe, L.

ROCK'S IMPROVED CARRIAGE-HEAD.

[Registered under the Act for the Protection of Articles of Utility. Messrs. Rock and Sons, of Hastings, Carriage-builders, Proprietors.]

Fig. 1, represents part of the body of a carriage (which may be of any convenient shape) with the improved head attached. The whole of this head is made to remove, being separated from the body at the elbow-line A, A, A, as shown in fig. 2, and it may be replaced by the ordinary carriage-head when desired. That part of the door which is above the elbow-line is attached to the improved

Fig. 1.

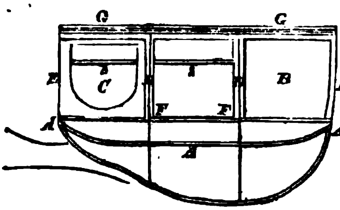


Fig. 2.

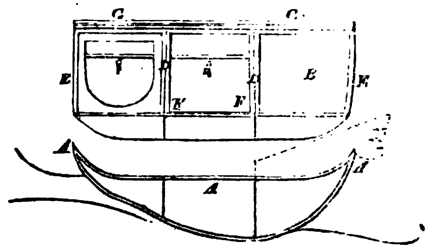
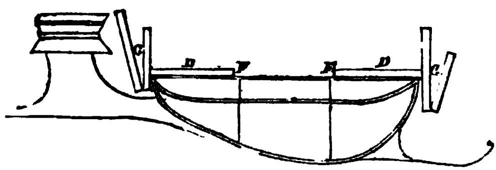


Fig. 3.



head, and is removed at the same time. The door-glass lets up and down in the door in the same way as that of a common close carriage. The upper side panels, or upper quarters, whether made plain as at B, or fitted with blinds, or with glasses, as at C, are made to slide into the upper half of the door, and then to let down into the lower half in the same way as the door-glass; the door and standing pillars, D D, being grooved and rebated to allow of this being done. The corner pillars, E E, may then be removed or let down by means of hinges, and the roof, G G, being attached to the standing pillars, which are jointed at F F, may be thrown open, as shown in fig. 3, or removed altogether by detaching the standing pillars at F F. So much of the improved head as is shown in figs. 1 and 3, is applicable to carriages without the total removal of the head, as shown in fig. 2, and the sliding quarter panels or glasses, dropping into the door, may be used without the other parts of this design.

PLAN OF AN INSTITUTION FOR AIDING DEPRESSED TALENT.

Sir,—Memorable as this country is for its various benevolent institutions, it is perhaps a little remarkable that TALENT is but too often allowed to pine in want and misery. The man who, by his genius and by fortuitous circumstances, has risen from the mass of the people to distinction in any branch of art or science, his name becomes the theme of many a warm eulogium when the orator is pointing out the progress of civilization, and lauding our national advantages in respect to arts and manufactures. Without question, we *are* a great manufacturing and commercial community. But, with the commercial spirit, unhappily, there is not associated a strong attachment to polite and mechanical arts. Is the patron of poetry, painting, and music generally a thoroughly commercial man? Or is *he* generally found foremost in giving encouragement to experimental inquiry relative to chemical and mechanical pursuits? No. The man of fortune and fashion contributes largely to supporting the former class, and the chemist and artizan look to the manufacturer. It is very true that there are such dependencies in society, that we find all classes amalgamating to a certain extent; but still we are not to be governed in our opinions by some glorious exceptions to a general rule, merely because those exceptions are more flattering to humanity than the leading principle governing a community. The commercial spirit

makes MONEY the standard of everything; it is always a first, and not a second consideration; and it is this spirit which induces traffic, irrespective of every reflection other than profit. The manufacturer is essentially a man of TASTE; he is generally governed by scientific principles, and is alive to all improvements to economize labour, to increase the beauty and value of his manufactures, and to give every possible completeness to articles of luxury or necessity.

Without dividing society into too many classes, we readily distinguish the man of independence, commerce, or manufactures. But there is yet another class, without whose aid manufactures might have remained to this day in the most unenviable simplicity of the arts of the rudest nations of the earth, and our commerce scarcely have exceeded that of ancient Tyre. To *that* class belongs a numerous train of INVENTORS, using the term in its largest acceptation.

The history of all poetry, painting, and philosophy—what a sad page does it exhibit to us, in regard to the fate of *inventors!* Strange that the birth of a new art should seem ever to subject its parent to the severest pains and penalties! But is it not so? Can any one be so grossly ignorant of the biographies of the innumerable martyrs to science, as to require the subject to be argued and proved? But what has long been the fate of too many sons of genius, need not necessarily longer continue. Their fate has *not* been a fate necessarily inseparable from pursuing labours fraught with benefit to mankind.

The village gardener, with his plot of ground, may make a comfortable living for himself and family, and may be even far removed from knowing a single day of actual want; and so with most ordinary every-day-life pursuits. The author, the artist, the mechanic, on the other hand, engaged on a task in their several departments calculated to be of the utmost benefit to arts and manufactures, being tempted out of the beaten track, lacking a plodding, commercial spirit, untrained in estimating the importance of the unvarying mercantile standard—*money*, how fatally situated often may the original author, the talented artist, the ingenious mechanic find themselves, when want stares them in the face, and when each eventually finds himself steeped in poverty. The poem and the painting may be incomplete, and the mimic machine may be a secret fortune-making scheme kept sacred, so that none of these three intellectual men can have the same resource as in the case already cited of the market gardener, and go to market with their produce. The case is too plain, and is, alas! too crying an evil not to be both readily understood and seriously lamented. Talent and capital too seldom meet. Necessity is so far the mother of invention, that the inventive, from necessity, often fly to invention for relief. In despair, valuable literary compositions have been sold for a mere bagatelle; in a necessitous moment paintings have been pawned; and even inventions have been disclosed for a paltry consideration; and so the original discoverer robbed and turned adrift.

The only remedy would appear to offer itself in placing an ingenious man above want, during the period he might be engaged upon any great work. About four years ago the writer took the liberty of addressing Lord Francis Egerton, now the Earl of Ellesmere, on the subject, and will presently detail the plan then suggested; but as nothing had been organized for actually carrying out the proposal, the correspondence terminated with a mere interchange of opinions. I was not then aware that something very similar had been proposed to Queen Elizabeth by Ralph Rabbards, in a communication he made to her majesty, of "moste pleasante, serviceable, and rare inventions."* He suggests to her, "to erecte some academy, or place of studdy and practice, for ingenious, pollitique and learned men, and apte artificers, as in a corporation or bodie pollitique, maintayned partly by your Majestie and partly by your nobillitie, your clergie, and your comons, for their moste noble effectes. And whereas many corporations, societies of artes, faculties, misteries, have bynne erected, founded, and franchised, with many honorable guiftes, liberties and freedomes, by your Majesties moste worthy progenitors, but never any comparable to this, in glorie to your Majestie and the safetie and comforte of your country and people, which

* "Halliwell's Collection of Letters on Scientific Subjects." Published by the Historical Society of Science. 8vo. London, 1841.

every virtuous and good mynded man would willingly further and maintayne for his own good and safetie, and to the perpetuall glorie of your Majestie, and your feirce people, and valiante nation, that ingenious pollicies mighte throughly joyne with strength and valiante hartes of men," (p. 12.) I have named to many persons my views, with a general outline of my plan, and I hope that by communicating the same to the public, through the medium of your excellent and widely circulated Journal, the idea may strike some man of fortune and patron of learning as affording a most important and gratifying employment for capital, and as laying the foundation for a monument enduring as the world itself.

Suppose on a suitable plot of ground a moderate extent of buildings were erected, arranged partly for workshops and partly for small residences, with stores for such ordinary matters as wood, metals, cordage, various kinds of vessels, some tools, and other common useful matters. Suppose farther, that this were a private and not a public establishment. On its being made known that such a foundation existed, with a certain fund set aside for the encouragement of talent in every useful walk of literature, art, or science, much interest would be excited to ascertain the regulations of such a valuable institution. The applications would be so numerous, that it is scarcely possible to surmise what one and another would offer. Many proposals would, no doubt, be too trifling, and the proprietor would have to inform many such applicants that he was neither a merchant nor speculator, and that while he admired the ingenious trifles presented, they were not of a character to come within the scope of the objects contemplated in the formation of the institution. Others would present themselves with exceedingly flattering schemes skeletoned out on paper, or represented in the glowing language of enthusiastic inventiveness; such would have, perhaps, to be informed that they seemed to possess only very crude notions, and that it did not appear that they had done anything calculated to afford the least proof of the practicability of their designs, and that it was not the object of the institution to stimulate any one to follow pursuits out of their proper calling, by offering them a premium to neglect their ostensible business, which was a certainty, to follow out visionary schemes, which might end in failure and shame. Again, there would be many of very mediocre talent professing to have made actual discoveries of great national benefit; too many of whom would have to be informed that they were in pursuit of a phantom, that their views were opposed to the simplest principles of the science on which their plans professed to be based; and many would have to be shown that all they suggested was already well known, and could be furnished more complete and perfect from the published abortive labours of equally sanguine fortune-hunters.

So far, I believe, this picture is but too correct; and before going farther, I would on this point remark on the only, or principal difficulty that I see in establishing a public, rather than a private institution of this nature proposed. The *individual* can act promptly, at his own discretion, without appeal, and without censure. No complaint can be made of favoritism, misapplication of funds, or misdirection of encouragement.

What the private proprietor of such an establishment wishes to attain, viz.: the doing the largest amount of good, with the smallest means, should equally guide a public institution, provided one were ever established for this eminently valuable object. The great aim should be to foster talent—by preventing, as far as possible, the loss to the community of any estimable work, through the pecuniary embarrassment of the workman. And to do this with the prospect of extensive usefulness, the institution should be based on a principle of becoming, to some extent, self-sustaining. To genius in the humblest circumstances it would offer a temporary home, workrooms and materials; to talent more favourably situated, but still in present difficulty, it would offer loans; and to every one it might afford a library ever open, and free to all comers. On an enlarged scale it might have its museum, exhibition, and lecture hall, for occasional use, particularly in giving publicity to the successful working of the institution. The institution might be self-supporting, so far as this, as to secure itself, as far as possible, from any actual loss for advances of money. Disap-

pointment or death might be the occasion of many losses, but such contingencies would be calculated on in the very formation of the establishment. The great object would be, to guard against actual loss of principal, after a work was successfully accomplished, and its author rewarded for his labour. The object of the institution being purely benevolent, and its sole aim being to uphold depressed genius, it would never design to make profit by those it supported; at the same time, as a nobler than a pauper-spirit, animates the breast of true genius, no truly clever, wise and good man would withhold from the society the means he had it in his power to refund, that so the same means might in like manner be extended to a brother in distress; indeed if it lay in his power, he would become a liberal contributor to its funds.

On occasion, the proprietor of the institution would have proposals laid before him, which would reasonably justify a course of experiments, to test some particular point in inquiry; but, generally, such a proposal would not be consistent with the objects of the establishment. It would rather be the desire of the proprietor to keep worthy parties out of the sphere of absolute want, during the progress of some ornamental or useful work towards completion, and not to establish an experimental laboratory. What a happiness would it have been to many an author, painter, artizan, whose life and works have been alike sacrificed, if he could have continuously kept at his labour for one or two years, without the dread of starvation, or of encountering, wherever he applied, the taunt of idleness, and "neglect of the shop." Intellectual employments require this leisure, and it will not be difficult to understand why, when this leisure is obtained at the expense of an individual, or of a public body, it should be paid back to the general fund.

An institution of this nature might be founded, capable of doing an immense amount of good. As a private institution, it would afford its noble-minded patron much pure delight and satisfaction, and far remove every complaint of want of pleasant employment. As a public institution, much care would have to be exercised in fully and clearly defining its object, and in not deviating from its original design, beyond what might be called for by an alteration in times and circumstances. Above all, it should be strictly guarded against degenerating into abuse, arising out of any jobbing in its affairs.

In a few words, and in conclusion, a benevolent institution of this nature should lend its kindly aid to depressed talent of every class and of every clime, not so much with any hope of originating talent in literature, art, or science, as with the desire to insure ingenious men and their works against the fatalities consequent on a want of fortune or immediate patronage. I am well aware of the incompleteness of this first sketch, but hope the hints so briefly given will prove productive of ultimate good, by stimulating those who have means and leisure at command to carry into effect the formation of an institution of the character here designed. I am, Sir, &c.,

HENRY DIRCKS.

32, Moorgate-street, London, June 10, 1848.

ROBERTSON'S PATENT IMPROVEMENTS IN THE PREPARATION AND APPLICATION OF COLOURS SUITABLE FOR PRINTING.—(COMMUNICATED FROM ABROAD.)

[Patent dated December 10, 1847; Specification enrolled June 10, 1848.]

Specification.

The colouring matters hitherto employed in printing textile fabrics composed of wool, of silk, and of wool and silk combined, are usually in the state of extracts, which are obtained by aqueous solution from various kinds of dye woods, and from other substances, such as orchil, cochineal, &c., and by evaporating more or less these extracts. But it often occurs that in using boiling water to extract these colouring matters, several other soluble substances are extracted along with them, so that when an aqueous solution of any colouring matter is evaporated, the residuum retains a great deal of these extraneous substances, and, consequently, produces colours less brilliant than if it were isolated and pure. Again, all aqueous extracts, particularly highly concentrated ones, deposit, in the course of time, the whole of the colouring matter, which is in a state of suspension, and likewise, in the majority of cases, a resinous substance, which has probably mixed up with it a portion of the colouring matter. And as the concentration or strength of the extract diminishes in proportion as the deposit increases, it follows that the liquor in any two vats must always vary more or less in strength, according as one may have stood longer than the other.

Now such differences of intensity necessarily cause irregularities in the printing of goods. Moreover, there are still greater irregularities arising from the fact that all extracts have not equal affinities for water, and, consequently, that some have a greater tendency than others to absorb steam; from which causes combined, steam printing (*le vaporisage*) is rendered an operation extremely uncertain in its effects and very liable to accidents. It has been usual to give to this process the name of "dry-dyeing" (*teinture seche*,) which would seem to imply that the employment of water is unnecessary, which, however, is not the case, for all manufacturers are careful to keep the goods moist which they wish to fix with the colours, either by placing them in a humid atmosphere, or by damping them during the process of steaming, by opening the steam cock a little at the commencement of the operation, so that the steam which escapes may be condensed upon the goods, and thereby impart to them the necessary degree of humidity. Without these precautions, the colours would be feeble and spotty in appearance, unless, indeed, the colours can be previously rendered equally hygrometric, which it is an extremely difficult thing to effect. If two pieces of the same printed fabric are submitted to the process of steaming, one very dry and the other very damp, the colour of the first will be feeble and spotty, while that of the second will be bright and full bodied. All printed woollen goods, with the exception of those which are printed with colours which, like French blue, have a great affinity for water, require, in order to the colours being firmly fixed, to have condensed on them the largest possible quantity of steam, either before or during the process of steaming, but without the quantity being so large as to allow of running (*coulage*) and if it should happen that in the same piece, and by one and the same operation, the colour runs in one part, is weak in another, or is clear and decided in a third, it must arise from the piece not having in all parts an equal affinity for water.

To remedy the various inconveniences arising from the use of extracts in steam dyeing (*vaporisage*,) it is necessary to replace those extracts by preparations in which the colouring matters are in a purer and more unalterable state, and which are such that they may be fixed in the goods in an uniform manner, and at a degree of humidity as analogous as possible to that of the dyeing bath; and this is what has been effected by the improvements to be now described.

These improvements are founded on the general fact, that if to a decoction of any colouring matter (a decoction of fustic, for instance) there be added a salt, such as the chloride or protoxide of tin, the base of which has a great affinity for the colouring matter, an insoluble precipitate results, which holds very little, if any extraneous soluble matter, and contains the colouring principle in a state of much greater purity than the ordinary extracts.

Although insoluble, this precipitate is capable of combining perfectly with the textile fabrics aforesaid, provided that the drying be performed while the goods are well damped. In consequence of the insolubility of this precipitate, the colour obtained by means of it, may be fixed by steam without any previous desiccation, and goods which may have been dried after printing, may be again wetted, without danger of the colours running. The precipitates which may be thus obtained and applied are numerous; but as they are all very similar in effect, it may suffice to specify those only which appear to be most susceptible of general use.

To obtain a precipitate of Cuba wood (*morus tinctoria*,) dissolve in water about 100 parts of chips; strain this solution through a silk cloth, and then pour into it, by little and little (stirring the mixture the while,) a solution of 10 parts of deuto-chloride of tin, dissolved in 20 parts of water and 4 parts of sulphuric acid of 66°. When the precipitate has been deposited, draw off the supernatant liquid, and wash it repeatedly with fresh water till no trace of the acid remains. The precipitate is then to be filtered and kept in a humid state till required for use.

To obtain a precipitate of fustic (*rhus cotinus*,) dissolve in water about 100 parts of chips; strain the solution through a cloth, and then pour into it, by little and little, stirring it as before, a solution of 10 parts of chloride of tin in 20 parts of hot water. When the precipitate thereby produced is deposited, draw off the supernatant liquid, and filter (without any previous washing.) This preparation is also to be kept damp.

To obtain a precipitate of woad, make a solution of 100 parts of woad, and add during the operation one part of subcarbonate of soda. Strain the solution through silk, and add, by little and little, stirring the while, a solution of two parts of alum dissolved in eight parts of warm water. Remove from the resulting precipitate the supernatant liquid, and filter without any previous washing. Keep damp as before.

To obtain a precipitate of orchil, make a solution of about 220 lbs. weight of orchil

prepared for dyeing, and strain the solution through silk; then add to it, by little and little, stirring the while, a solution of about 49 lbs. 8 oz. of alum, free from iron, in about 104 quarts, more or less, of warm water; agitate this mixture for five or six minutes, and then add a solution of 8½ parts of subcarbonate of soda in 16 parts of warm water. When the precipitate is deposited, draw off the supernatant liquid, filter the precipitate, and keep it damp as before.

To obtain a precipitate of cochineal, make a solution of 25 parts of cochineal, strain it, add by little and little, stirring the while, a solution of 6½ parts of protochloride or muriate of tin, (*chlorure stanneux*,) and the like quantity of chloride of tin in 29 parts of warm water. Draw off the supernatant liquid, filter the precipitate without washing, and keep it damp.

By means of one or other of these precipitates, and with the aid of the soluble blue or indigo-vat, (*carmin d'indigo*,) to be met with in commerce, all the shades of golden yellow, of jonquil yellow, of violet, of Parma violet, of green and other composite or fashionable colours, (*couleurs de mode*,) may be obtained. For example, a golden yellow may be produced by taking about 4 lbs. 6 oz. weight of a solution of gum Senegal, of medium density, and about 2 lbs. 3 oz. of the precipitate of fustic, mixing the two ingredients well, and adding about one ounce and a half of oxalic acid dissolved in a little water. Green may be produced by taking 5 lbs. 7½ oz. of the precipitate of *morus tinctoria*, and dissolving therein by heat about 1 lb. 9 oz. of gum Senegal, about 6½ oz. of alum, about 2 oz. of oxalic acid, then mixing all these matters well together, and adding about 5 lbs. 7½ oz. of an aqueous solution of gum Senegal, and 1 lb. 1½ oz. of soluble blue or indigo-vat, (*carmin d'indigo*,) well levigated with an aqueous solution of gum. Or a green of another shade may be produced by taking about 5 lbs. 7½ oz. of the wood precipitate, dissolving it in about 2 lbs. 3 oz. of gum Senegal, adding to it about 4½ oz. of alum, about 1 oz. of oxalic acid, and about 1 oz. of chloride of tin, then mixing these matters well together, and finally adding soluble blue or indigo-vat till the particular shade desired is obtained. Or a scarlet may be produced by taking about 2 lbs. 3 oz. of the precipitate of cochineal, mixing it intimately with about the same quantity of warm solution of gum Senegal, and then adding about 2½ oz. of oxalic acid and the like quantity of oxalate of potash. Or, finally, a Parma violet may be produced by taking one part of an aqueous solution of gum and mixing it up thoroughly with the same quantity of the precipitate of orchil. As all the colouring principles which form the bases of these colours are insoluble, fabrics printed with them ought to be quite damp when exposed to the influence of steam.

Fabrics printed by rollers should be exposed to the steam for 35 to 40 minutes without having been previously dried; but after having been wound as usual on folds of dry calico. Fabrics printed by hand with one or more colours, *à la Perrotine*, should be first regularly and properly dried, and then damped again by rolling them on wet calico. After this operation, the duration of which will vary according to the nature of the fabric and the kind of printing, the goods should be exposed to the steam for 35 to 50 minutes.

From what has been thus stated it will be seen that the great distinction between the ordinary modes of preparing and applying the colours aforesaid and those herein specified, consists in this, that by the ordinary method the colouring matters are soluble, and always accompanied with brown matters which impair their purity; and besides, as they strongly attract the damp, but unequally, they cannot be steamed or vapourized very completely without running; while by the improved method now specified, the colours being purified and rendered insoluble by a previous preparation, the result is that they can be fixed uniformly by steaming, and that on account of this same insolubility, the steaming can be effected in the presence of a great deal of water; which allows of the operation being abridged, while a perfect combination of the colours with the fabrics is effected.

And having now described the nature of the said invention, and in what manner the same is to be performed, I declare that the improvements which are claimed as constituting the said invention, are as follows:

First, The mode or modes of preparing the colours aforesaid, before described, from insoluble precipitates instead of soluble extracts; which precipitates, notwithstanding their insolubility, combine perfectly with the fabrics.

And, *second*, the application of the colours thus obtained to the printing of stuffs composed of silk or wool, or of a mixture of silk and wool by the process of steaming (*vaporisage*) before the printed fabrics have been dried, or when they have been wetted afresh, after having been previously dried.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?—PROTEST BY GENERAL SIR HOWARD DOUGLAS AGAINST THE REPORT OF THE DOVER HARBOUR COMMISSIONERS.

[Continued from page 573.]

Article 23.—6. My gallant and highly esteemed friend, Major-General Pasley, gives the following account of his conversion to, or adoption of, the theory of the upright wall: "For many years I paid no attention to this subject, but thought that the long flat slope adopted at Plymouth Breakwater must be the best form for resisting the sea, not only from the reputation of the eminent engineer and naval officers by whom this construction was proposed, but also from the circumstance of its having been approved and carried into execution by order of the Government of that day. But in the year 1842, when this question was publicly discussed at one of the meetings of the Institution of Civil Engineers,* at which I was present, after a paper of Lieutenant-Colonel Jones, R.E., had been read, in which he gave the preference to upright walls, as being much more secure than breakwaters or flat slopes, and stated his reasons for this opinion, the arguments in favour of the former appeared to me to preponderate. I have since given the subject much attention, and have made inquiries and observations, which have confirmed me in this impression."

A practical opinion from so distinguished a military engineer must ever be considered as entitled to a degree of confidence which no theoretical opinion can overthrow; but I hope I do not disparage the scientific acquirements of my gallant friend when I venture to refer to one of the most eminent authorities that can be adduced, whether as a pure or a practical mathematician, the Professor of Mathematics in the Hon. East India Company's seminary at Addiscombe, the Rev. J. Cape, who, in an admirable paper, confirms entirely those views which I had formed on the scientific and practical conditions of the case, and of which he authorizes me to make any use.

The ample discussion which this important problem in hydraulic and engineering science must now undergo, with reference to the great national work to which the endeavour to do my duty, under peculiar and difficult circumstances, relates, will enable the Government to form a sound and safe opinion as to the mode in which it would be justified in sanctioning a measure of such magnitude, and Parliament in providing the means of putting the work in execution. It appears to me, however, that the problem may be considered to have been as fully solved in this country, by the successful completion of the Plymouth Breakwater, as the engineers of France conceive it to have been by the construction of the works of Cherbourg, and those of the United States, by what has been executed in Delaware Bay. These prove that, for the basis and body of the work at least, the slope may be most safely and advantageously adopted, whatever be the form to be given to the superstructure. It has been said that the objection to the adoption of the upright wall from the bottom, on the ground that it "is experimental," is one which would arrest improvement founded on legitimate induction in hydraulic engineering. But experiment has been made to a certain extent at the places I have mentioned, which so far settles the question, that there is no need to postpone the commencement of this great work till new trials be made; and it does appear to me, that to introduce the upright wall in lieu of the slope, would be to retrograde, and not to advance; to act against mathematical demonstration, and to work against the laws of nature.

I may as well here refer to another eminent mathematician, pure and practical, Mr. Narrien, Professor of Mathematics in the Royal Military College, who denies and disproves the assumptions upon which the theory of the upright wall is based; and I have it in my power to name many other first-rate authorities, men of science, and military as well as civil engineers, who concur in condemning such a mode of construction.

My gallant friend, General Pasley, observes, "Nature points out the bluff or vertical form as the best for solid materials, since all sea coasts composed of any sort of rock, and even of chalk, are in that form, and do not suffer by the action of the sea. If they did, they would of course soon be breached by the violence of the waves, and the fragments would assume some sort of slope, gradually flattening until they offered less resistance. As the sea wall proposed for a harbour of refuge in Dover Roads, like every substantial wall, must, in fact, be a sort of artificial rock, stronger than any natural rocks, let it be built in that form in which nature has arranged the rocky coasts of the sea in every part of the world, namely, in the vertical or upright form, and it will be equally safe."

Upon this I refer Major-general Pasley what Sir H. De la Beche states, that "the

* The opinions delivered were 6 to 1 against the upright wall.

blow, the crash, the ruin produced by seas on bluffs and cliffs, and the enormous inroads made accordingly, until those cliffs are protected by sloping beaches formed by their fragments," and that the vertical or upright cliff is incapable of resisting the action of the sea.

Article 24.—7. Captain Vetch is the next authority cited in favour of the upright or nearly upright wall, both from theory and practical observation.

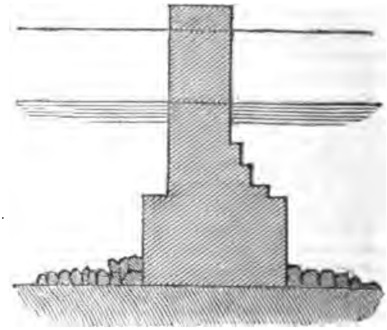
Now, first as to practice; he says, in reply to question 864, that he does not know of any instance in which an upright wall has been constructed in the open sea, in seven fathoms water.

In answer to question 865, he states that, not having an instance before us of any upright wall having been executed in seven fathoms water, he admits that such a mode of construction would be experimental, and may justly create a diffidence.

In reply to question 926, he admits that all the cases of upright walls to which reference has been made, are piers built in shallow water.

On account of the extraordinary difficulties of constructing a harbour of refuge in Dover Bay, he thought that the best mode of executing such a work was by the system of caissons which he proposed. With respect to the combination of a slope with an upright or nearly upright face for the superstructure, he, Captain Vetch, said (answer to question 931) it would be highly advantageous; that it would obviate a great many objections to the present condition of the Plymouth Breakwater; it would prevent the waves breaking over, and would give security to erections on the breakwater itself. The works now going on at Cherbourg, which had been erroneously considered to be an abandonment of the slope in favour of the upright wall, is only a combination of both; this he thinks a great improvement, and adds, that such a breakwater at Dover would be very superior to one entirely sloping. Captain Vetch recommends brick in cement for face work, and suggests blocks of brick firmly agglutinated into a mass by means of a cheap flux between the joints; the mass of brick blocks being subjected to the requisite heat by means of flues or otherwise.

Article 25.—M. Reibell is the next authority adduced in support of the upright wall; and a sketch, of which the annexed is a copy, is inserted in the proceedings of the Commission (Appendix, No. 23, page 97,) to sustain, as it would appear, the proposition of the upright wall, which it is inferred the French engineers, as a body, approve, and would adopt, if the breakwater



in Cherbourg Bay were to be commenced *de novo*.

Captain Washington, in his Report on the breakwater at Cherbourg (3 December, 1845, Appendix, No. 23, page 95,) states, that "M. Reibell, the present engineer, is decidedly in favour of an upright wall, and recommends the form shown in the above sketch as "the best for opposing the shock of the waves."

I stated to my colleagues distinctly, that I was very certain the French engineers, civil and military, would not concur in such a proposition; and I venture now to repeat my firm conviction that such a mode of construction would be impracticable in the open sea, in seven or eight fathoms water; and that if by miracle such a wall could be set down, well founded and put together, in Cherbourg or Dover Bay, it would not survive the first storm.

According to the scale taken from the depth of water, the breadth at top cannot be above 15 feet. Exclusive of deficiency in the mass, to resist the force of waves, there would be no emplacement for batteries nor room for traffic.

Article 26.—9. Mr. Brunel is next adduced as having given his opinion in favour of an upright wall for the construction of breakwaters. But Mr. Brunel was not examined before the Commission, and the only opinion which he has given upon this subject is that contained in the annexed extract of a letter from Mr. Brunel, addressed to the Chairman, dated 19th June, 1844:—

"Upon one point upon which I understand the Commissioners to have sought an opinion, I have no hesitation in expressing my concurrence in those which I am told have been generally expressed in favour of vertical sea walls, in lieu of slopes, where the nature of the material to be used, and other circumstances, admit of such a plan being efficiently and economically carried out."

This seems a summary, off-hand opinion, which could scarcely have been intended to

appear in a public document, as the professional advice and opinion of a distinguished engineer, upon a question of such national importance as that of constructing a breakwater in Dover Bay, in seven or eight fathoms water. It would be very desirable that Mr. Brunel should be fully examined, or that specific questions should be put to him touching this matter; for as I read the preceding extract, Mr. Brunel's opinion is given with reference to sea walls, such probably as he is now constructing on the coast of Devonshire, and not breakwaters for the deep sea.

Article 27.—10. Mr. Bremner is next adduced as an authority in favour of the upright wall. Mr. Bremner is an uncommonly intelligent and ingenious person, and to him is justly due whatever merit there may be in recommending caissons as utensils, in which immense portions of ready-made breakwaters may be built at remote quarries, and thence transported to the locality where they are to be used, there to be stranded on the bottom of the sea in deep water, as proposed by Mr. Walker in his project for constructing a Harbour of Refuge in Dover Bay. Such an expedient may be useful for works on a small scale, and in shallow water, such as those for which Mr. Bremner appears to have designed them; but seeing the defects and dangers of such a system of caissoning in the perilous condition to which Westminster Bridge is reduced, and the universal condemnation of the adoption of such a mode of construction in deep water, it is scarcely necessary to make any further observation on so preposterous a proposition. It may be observed, however, that Mr. Bremner's proposition of the upright wall is incidental, and belongs only to his scheme of transporting ready-made breakwaters in caissons from remote quarries; since to give to huge vessels of about 300 or 400 feet in length, width sufficient for the base of a breakwater having any considerable slope, would immensely increase the already preposterous dimensions of these "utensils."

Article 28.—With the greatest possible respect for all these able and eminent men, I must say, that I do not find anything in what they have adduced that can, in my judgment, warrant the adoption of the mode of construction which they recommend; it does not rest upon any proved principle, is untried upon any sufficient scale to justify its adoption in a great national undertaking, and all agree in designating it experimental.

When I find it stated, in the summing up of the Commission, that the opinion of Mr. Alan Stevenson in favour of a sloping breakwater is the "sole exception" to those of the other men of distinguished science and practical observation who have been called upon to advise the Commission on this important subject, I feel bound to interpose against the conclusion arrived at, Sir John Rennie, Mr. George Rennie, Mr. Cubitt, Mr. William Stuart, as well as Mr. Alan Stevenson, who all disapprove of any attempt to construct an upright wall in the open sea at Dover; and they distinctly express their opinion, apprehension, or conviction, that such attempt would end in total failure; and when to this I shall have added what I have yet to say upon the subject of Cherbourg, Plymouth, and Delaware breakwaters, works actually constructed on the principles which the new theory would abandon, and shall have adduced the opinion of the most eminent and enlightened engineer of France, I trust I shall be considered to have made a good case in support of this dissent.

Article 29.—There is no part of the Report of the 28th January 1846 from which I more decidedly dissent than that which refers to Cherbourg Breakwater as a failure, and as "an attempt which may serve as a warning to those who may have to decide upon the construction of such works in this country," that they avoid entirely the principles upon which that work has been constructed.

It is a matter of much importance, preparatory to the execution of the great work to which this paper relates, to examine thoroughly the actual results, and study carefully the lessons derived from observations made on the progress of the works at Cherbourg, which are now advanced so far that they will enable us to form a good judgment of the merits of the system on which they have been constructed.

Having personally inspected those great works, and being in possession of ample information respecting their origin and progress, with all the details of execution up to the present time, I deem it my duty to endeavour to correct some very erroneous impressions which the references above adverted to are calculated to convey. I allude particularly* to what has been adduced in Appendix No. 23, on the authority of M. Reibell, Inspecteur Divisionnaire adjoint des Ponts et Chaussées, as implying a proof that the French engineers condemn the slope, regret that it had ever been used, and would, if the breakwater in Cherbourg Bay were to be again executed, adopt in preference the upright wall. This has been stated on several occasions, so that an impression has been created to the disparagement of the French engineers who have been concerned

* See the Sketch, Article 25 of this Paper.

in remodelling and completing that breakwater, as if they had been deficient in scientific foresight; and a like impression cannot fail to arise to the prejudice of the engineering operations of this country, with respect to the breakwater at Plymouth, in consequence of the British engineers having put in practice a mode of construction (the long slope) which their neighbours on the Continent are said to repudiate. It is, therefore, of the utmost importance to investigate the history and actual state of the Cherbourg Breakwater, in order to ascertain, exactly, what ought really to be avoided, or what may with safety be adopted, in the greater work which it is now proposed to construct on our own shores.

Article 30.—From observations actually made by some of the highest geological authorities of this country, we learn that the percussive force of waves on precipitous coasts and cliffs is accompanied by a destructive abrasion of the rock or soil, creating in some cases vast encroachments of the sea on the land. The abrading force is found to continue till the cliffs are washed away, or fragments are deposited at the foot of the rock in such a manner as to afford a protecting beach with a slope sufficient to prevent any further encroachment. And I may add here, that the great experiments which have now been made at Cherbourg and elsewhere, prove sufficiently that the action of waves on artificial constructions in the sea or on the coasts, is to reduce the masses so that their sea-fronts are brought to the form of long and gentle slopes, and not to transform a gentle slope into one more steep, still less to bring the face to a vertical form.

These observations and facts appear to me to afford distinct warnings not to attempt the construction of an artificial island in Dover Bay (in seven fathoms water), with a vertical face similar to that of the cliffs which, on the coasts of Great Britain and Ireland, are known to have been undermined, and to have had immense portions washed away.

Article 31.—Annex (M.) is a brief historical account of Cherbourg Breakwater from the commencement, together with an extract of the Report of the Commission of the Institute of France, of which Prony and Charles Dupin were members, and Girard rapporteur. These eminent men, after a careful inspection of that work, and after having investigated the whole process of its execution throughout, reported that the failures which had taken place arose, not from its having a sloping face, but that the slopes were not long enough to resist the action of the waves; that no constant degree of slope is calculated to resist the different actions of the sea at different depths; that these actions reduced gradually the masses of stones forming the original dyke, to a profile having different degrees of slope, and that this necessarily diminished the height of the work at different times. They added that the whole mass was thus, at length, brought into a state of the most perfect stability; and all this was verified by the United States Commission.

Article 32.—The first great lesson really taught by the work in Cherbourg Bay, as a warning what to avoid, is that the system of caissoning should not be adopted; the next lesson is to avoid the use of small stones deposited *à pierre perdue*; the third lesson is, not to construct the sea-face of breakwaters in one uniform slope from the bottom, but to form the profile with two slopes, and to make the slope far longer than that which was originally designed for the work. The result of this extensive experiment demonstrates first, how insufficient and incompetent mere theory and speculation are, to fix within precise limits the degrees of resistance which should be given to a work exposed to the violent efforts of the sea.

We find that the mass of materials originally deposited in Cherbourg Bay, was heaped up so as to form too steep a slope, and that the agency of tempestuous waves has disposed of them by reduction to a form which secures their permanent stability:

That the part of a breakwater which is above the highest level of spring tides, is so little exposed to the action of waves (which must have lost by their ascent a portion of their momentum ere they arrive there), that it may be more steep than the part below.

We learn also that the part of the breakwater between low water and high water, spring-tide level, is exposed to the greatest violence of the waves during the whole of the rise and fall of tides; and that there the slope should be longest, or the inclination of the face to the horizon should be the least.

Captain Washington states, in his report on the breakwater at Cherbourg, "that the long slope of ten to one, formed by the action of the waves, from low-water mark upwards, has not varied, not even in the gales of 1808, 1824, and 1836, the most memorable on record." There cannot be better evidence of the stability of the long slope.

That the part of the breakwater for a certain distance below the lowest spring tide, is exposed only to the shock of waves towards the termination of the fall and the commencement of the rise of tide; that

there the slope may be steeper, or the inclination to the horizon greater; whilst at the lowest part of all, or that which remains permanently submerged the slope may be still more steep, or have the greatest inclination to the horizon.

With respect to the magnitude of materials, we find that small stones have not sufficient stability to withstand even a moderate action of waves.

That stones of from one and a half to two tons weight, are sufficient to resist the effects of a moderate sea.

That blocks considerably larger are required to withstand violent seas.

That when small materials are used, it is indispensable to cover them with blocks of large dimensions.

That very large blocks should be placed towards the top of the work, to compensate by their weight the loss of stability caused by the total immersion of the materials beneath, for these lose as much of their weight in water, as is equal to the weight of water displaced.

The last fact to be noticed respecting the work at Cherbourg constitutes a very decided warning against the use of blocks of concrete, adverted to in question 153, which was proposed by Captain Denison, 21 November, 1845; for the application of this material on a large scale has entirely failed; the blocks of concrete having broken to pieces.

The imperfections of the original project being corrected, the breakwater at Cherbourg is now proceeding rapidly to completion; and far from being a warning that that those who have to decide upon the construction of a Harbour of Refuge in Dover Bay, or elsewhere, should avoid the principles and reject the form which has been observed in its construction, it demonstrates in the most forcible manner, that the theory of the upright wall should be rejected, and that in its place should be adopted the well-tried slope, or rather a combination of different slopes; while a nearly upright wall may be formed above, to serve for the facing of a parapet like that which crowns the work at the French port.

Article 33.—The United States engineers, as a body, are well educated, ingenious, cautious, able, and practical men. Annex (L.) is a copy of the Report of a Commission, composed of naval officers, engineers, and architects, who were sent to Europe in 1829, to inspect and report upon Cherbourg Breakwater, Plymouth Breakwater, and other such works, with a view to the erection of a breakwater in Delaware Bay. Now that document, as well as the more recent Report of the approaching completion of the work, shows that the American engineer who had conversed with Colonel Jones upon the subject of the breakwater in Delaware Bay, misinformed him when he stated that, in the United States, they did not approve of the long slope.

Article 34.—The Report to which I refer contains an able investigation of the whole process relating to the breakwater in Cherbourg Bay; and it takes notice of the advantages which accrued to us in constructing the Plymouth Breakwater, from the valuable information deduced from the experimental results of the French work. It demonstrates the success of both, and recommends that those stupendous works should be adopted as guides, with respect to the leading principles upon which the Delaware Breakwater should be constructed. These have been followed; the dimensions of those works have, as is recommended in the Report, been adopted, and the breakwater has accomplished the purposes for which it was projected. Notwithstanding this, our Commission would have us take warning from that Report, and avoid the mode of depositing blocks of stone for the purpose of forming a breakwater with a long slope, treating that mode as an experiment that has failed; and it would urge those who have to decide upon the construction of such works, to adopt a method which has never been tried on any scale that could warrant the employment of it in so great an undertaking.

Article 35.—Now, persons who read cursorily that part of the Report to which I have referred (page 8 at top, question No. 152, and appendix No. 23) may imagine that the old dyke at Cherbourg had been taken down, and that the vertical wall which has recently been built, is raised from the natural bed of the sea, to the exclusion of the slope; whereas it is, in fact, merely a parapet with a nearly vertical face placed on the original breakwater, to prevent the waves from rushing over the terre-plein, after their force had been expended or greatly diminished, in ascending the long slope or glacis in its front.

Article 36.—I stated to the Commission repeatedly my conviction that the French engineers would reject, as unsound in principle and dangerous in practice, such a mode of construction as that which is inserted in our proceedings on the authority of M. Reibell; but as the question of construction were decided by the junior members of the Commission, before my opinion and vote were taken, and as the references to Cherbourg Breakwater, and to the supposed opinion of the French engineers, may have had some influence in bringing the majority of the Commission to conclusions favour-

able to the upright wall from the bottom, and may tend to produce an impression to that effect on the public mind in this country, I repeat now, on the authority of the very highest, the most experienced civil and military engineer of France, or probably that the world ever knew, that "all the enlightened engineers of France do continue to adopt, and will continue to construct breakwaters with inclined slopes, and do reject the theory of the upright wall; that the only alteration they would make if the work were to do over again, is in the degree of slope, which they would make variable according to the nature, specific gravity, and magnitude of the materials used; that the walls now being erected at Cherbourg, are not upright from the naked bottom of the sea, but built as a parapet, upon a well-consolidated basis; this being the breakwater previously formed *à pierre perdue*, whose slope has different degrees of inclination to the horizon, according as the action of the sea has reduced the original mass." That great work now stands in the form of a combination of the slope with the upright face for the superstructure; a profile which Rendel, Rennie, Cubitt, Vetch, Stuart, Colonel Harry Jones, Vignoles, and others recommend, but which Professor Airy (Appendix 14, page 88, Article 3,) says, speaking of an entire breakwater so formed, is, theoretically, "without doubt the worst of all."

Article 37.—That there may be no mistake upon this important matter in reference to Cherbourg Breakwater, unquestionably the greatest piece of hydraulic architecture that has ever been executed, I insert a profile, showing a combination of the long slope with the vertical parapet and its fore-slope of stones; and I add the reasons which induced the French engineers fourteen years ago to recommend such a superstructure.

This combination was proposed for the completion of the breakwater by Mons. Duparc, director of hydraulic works at Cherbourg, and sanctioned without modifications by the Minister of Marine in April, 1832, on the advice of a special commission, to which that proposition had been referred; but so far from pulling down the ancient dyke, as stated in the Report (Q. 152, p. 8, at the top,)* it was raised from the level to which it had been reduced from not having slope enough, by depositing large blocks of rough stone up to the height of low-water spring tides; and on it there was laid a mass of concrete, about one metre thick, on which a wall or quay is built to the height of three metres and a half above high-water spring tides. The exterior side of this quay or wall, is protected by a fore-shore of great blocks of stone, extending in a slope of 40 metres to the depth of seven metres below low-water mark. The object of these blocks is stated by M. Virla to have been twofold. The inclined surface of this fore-slope makes, with the face of the wall, a re-entering angle which might have been avoided in part by adopting the concave profile of Mons. Emy, but which in this case was not thought necessary, inasmuch as the artificial beach of great masses of stone, the principal object of which was to give to the slope of the dyke perfect stability, produced in addition an important effect in resisting the action of the waves at low water. It is found, in fact, that the waves which break on the surface of a long slope, have time to deaden their force against the asperities of the blocks which form the slope before they strike the re-entering angle of the foundation; and as the sea rises, and the time of high water approaches, the slope in front produces the effect of an ordinary beach in turning and throwing up the waves, which would otherwise break against the wall with extreme violence at the moment of their maximum of intensity.

(*To be continued.*)

* 152. Is it not the fact that, from the engineer not being able to maintain that form, it was obliged to be pulled down to three feet below the level of low-water spring tides, and that, at present, it is in the form of a vertical wall?—Yes, I believe so.

NOTES AND NOTICES.

Balancing the Wheels of Locomotive Engines.—At a meeting of the Institution of Mechanical Engineers, held at Birmingham on Tuesday last, Mr. M'Connell read a paper "On the Balancing of Wheels." The proper balancing of the wheels of locomotive engines was stated to be a very important matter, as most of the railway accidents, in cases where the carriages had jumped off the line of rails, were to be attributed to a want of proper balance in the wheels of the engines. The merit of the discovery of the proper balance was due to Mr. George Heaton, of Shadwell-street Works, Birmingham, who, when employed by the Earl of Craven, had occasion to examine a lathe which jumped in a very violent manner, and in the pulley of which he discovered a want of balance. This defect he remedied, and the lathe afterwards worked properly. Mr. M'Connell went on to detail instances of Mr. Heaton's experiments, and then read some accounts of accidents on railways, which appeared to have resulted from the cause to which he had alluded. After an explanation of the central forces of wheels, the speaker proceeded to exhibit, by models, proofs of his statements; passed on to describe the usual manner of balancing the wheels of locomotive engines, which, he contended, was an improper one; and concluded by illustrating, by another model, the necessity for obtaining an accurate balance in the piston rod. On this subject, however, he promised to read a paper at a future meeting...... Mr.

Middleton expressed his gratification at the notice which was now being directed to the subject, and said that hitherto much prejudice had existed against the discovery. The same description of model as that now exhibited had been shown to the engineers of the London and Birmingham Railway ten years ago, and although an engine which oscillated very much had been balanced for that line by himself and Mr. George Heaton, and had been perfectly cured, yet no further notice had been taken of the matter. He trusted, however, that Mr. Heaton was now about to reap the reward of his discovery. ......Mr. M'Connell said it was about seven years since Mr. Heaton came to him with an explanation of the system, and he (Mr. M'Connell) then balanced the engines on the Gloucester line. He believed that this was the first railway in England on which the invention was used.—*Midland Counties Herald.* For a full description of Mr. Heaton's views on this subject, see *Mech. Mag.* current vol., p. 447.

Fall of the Meiklewood Suspension Bridge.—We regret to say that this handsome and useful structure across the Forth, which was erected 17 years ago by the late Colonel Graham, of Meiklewood, fell into the river on Monday last, in consequence of the dry rot having seized the principal timbers. This bridge was erected on the thrust and tension principle, which is the same as that which sustains the tube lately erected across the Conway, having a span of 400 feet. The span of Meiklewood-bridge was 101 feet; and as a proof of the strength of this principle of structure, the bridge continued to carry heavily loaded carts for months, if not for years, after the dry rot had so pervaded the timbers, that almost the whole body of the beams were decayed. The main beams were of memel, of excellent quality, and had not the slightest appearance of taint, or rot, when erected. The disease had partially extended to the eyerights and other parts of the woodwork. On the Thursday preceding the fall, five carts heavily loaded with barley passed along the bridge with safety—slight symptoms of the decay were observed on Saturday. The bridge fell when no man was upon it, and when parties sent to inspect it were just approaching. The wreck is now being removed from the bed of the river; but, from the excellence of the iron material, and closeness of the fittings, there is great difficulty in getting the structure asunder. The want of communication between the counties of Perth and Stirling, at this point, is seriously felt; and we have no doubt but that measures will speedily be taken for having the bridge, which has so unfortunately fallen, replaced. —*Scottish Railway Gazette.*

American Steamers.—Dr. Scoresby remarked, in a lecture which he lately delivered at Bradford, that the recklessness and daring of the Americans were remarkable, and might be well illustrated by the value which appeared to be set upon life in their steamers. British steamers sailed across the Atlantic at a pressure of steam from 5 lbs. to 7 lbs. on the square inch. The American Atlantic steamers profess to work at a pressure of 20 lbs. on the square inch, and the North River steamers at 16 lbs. to 20 lbs., and sometimes 30 lbs., on the square inch, while on the Mississippi, a pressure of 80 lbs., 100 lbs., 120 lbs., and even higher, was had recourse to. It was, consequently, very easy to account for those tremendous explosions so frequently occurring on those rivers. Dr. Scoresby mentioned several of these explosions as cases in point—showing that the passengers were equally to blame with the captains of the steam-boats.

New Cement.—The *Buffalo Journal* (U.S.) describes a valuable cement, which was first discovered in Sharon, Medina County, Ohio, and after undergoing the most thorough tests has been pronounced of great value. The *Cleveland Herald* says, "The mine itself is one of the most singular depositaries to be found. It seems as if poured into a large sandstone basin, covering some four acres, is found at the depth of twenty feet, presents an even level surface, is about five feet thick, and when dug out is no harder than tallow, and is entirely free from dirt and other impurities. An exposure of two weeks to the air changes the cement to stone so hard that it is difficult to grind. In preparing it the cement is first ground when green, and after it has hardened it is ground again, and remains in a powdered state until mixed with oil for use. When applied to roofs it becomes hard and durable as slate, and is completely fireproof. The roof presents the appearance of fine slate, and is in no way affected by the weather. We have been shown a specimen of the cement that has been on wood nine months, which adheres closely, is as hard as the slates used in schools, shows pencil marks equally as well, and has the grit of a fine hone. The cost is small, being three dollars per hundred weight, which with the same amount of oil, is sufficient to cover 1200 square feet."

Death of the last surviving Son of Watt.—Our obituary of this week records the death of James Watt, Esq., the last surviving son of the illustrious improver of the steam engine. He was born on the 5th of February, 1769, and was, therefore, in his 80th year. Inheriting a large share of the powerful intellect of his distinguished father, to the extension of whose fame he had for the last thirty years shown the most zealous and truly filial devotion, he united to great sagacity and a masculine understanding the varied acquirements and literary tastes of a well-cultivated mind. His name will long be remembered in association with that of the late Mr. Boulton, as they were for nearly half a century successfully engaged in carrying out those inventions and improvements by which the genius of his father was immortalized. For the last eight years of his life, he had comparatively retired from active business, and had devoted much time and attention to the improvement of his extensive estates in the counties of Radnor and Brecon, where his tenantry, will have to lament the loss of a kind, energetic, and liberal landlord.—*Birmingham Journal.*

Clocks and Watches.—At the last meeting of the Society of Antiquaries there was exhibited a valuable series of watches of all ages, belonging to Mr. Morgan, and also a collection of watches and portable clocks belonging to the Clockmakers' Company. Some remarkable drawings were on the walls, including three views of the death's-head watch which belonged to Mary Queen of Scots, with her name and the date on it, which we believe is now at Windsor Castle, together with the antique clock formerly the property of Horace Walpole, and sold at Strawberry Hill. Perhaps so many specimens of by-gone ingenuity and gradual improvement in the art of watchmaking were never at any former time brought together; and several of our most eminent mechanics in this department (including Mr. Vulliamy and Mr. Vines) were present on the occasion. The very singular dial, with sixteen faces, by Holbein, the painter, and Cratzer, the celebrated watchmaker of that day, was also introduced as an illustrative object. The exhibition was followed by the reading of the conclusion of Capt. W. H. Smyth's paper on the portable clock, the property of the Society, which was made in Bohemia, in 1525, and presented by the Emperor Sigismund to his sister, Queen Bona. It seems to have come into the possession of the Society, by bequest, considerably more than half a century ago, but has never yet been described. Indeed, it would still have remained unknown but for the research and acuteness of the Director, who found it when Mr. Albert Way, the late Director, was making out his catalogue of relics, antiquities, and curiosities in the presses, cabinets, and cases of the Society. Capt. Smyth's more general dissertation was followed by a minute and valuable description of the ancient machinery and works of the clock, by Mr. Vulliamy.—*Athenæum.*

Armstrong's Hydraulic Engine.—The following description of the operation of an engine now in use at the Albert Dock, Liverpool, is from the *Newcastle Journal*:—"The question is constantly asked, how does the engine go by water? And, as much misapprehension appears to prevail upon the subject,

we shall endeavour to answer the inquiry. It will be observed, that the engine has two cylinders lying at an angle with each other; each of these contains a piston, upon the alternate sides of which the moving power is exerted in the same manner as in the steam engine. But where, it is asked, does the water come from, and where does it go to? The answer to this is as follows:—The water company have two main pipes in the adjacent street, one of which communicates with a reservoir at Carr's Hill, situate at an elevation of 420 feet above the Tyne, and the other with a reservoir at the head of Gallowgate, the height of which is 230 feet above the same point, so that there is a difference of elevation between the two reservoirs of 190 feet, and a corresponding difference of pressure in the water supplied from each, which difference is equal to about 82 lbs. on the square inch. Now, the engine being connected by branch pipes with both of the street mains, the pistons are acted upon by the pressure of the Carr's Hill water on the one side, and by the opposing pressure of the Gallowgate water on the other, and the engine is, consequently, put in motion by a force equal to the difference between the two pressures. By this means the water, instead of being run to waste, merely passes from one set of pipes to the other, and remains available for the use of the town. The engine is worked by slide valves, which, we are informed, are so constructed as to afford very wide passages for the water, without occasioning an undue pressure on the face of the slides. There is also, we are told, an arrangement for liberating the water in the cylinders at the time when the valve ports are closed, which enables the engine to turn each stroke with the same freedom as the steam engine. At any rate, certain it is that all impediments to the attainment of high speed and easy motion are removed in this engine, and there appears to be every probability of its coming into extensive use, not only in cases where steam engines are considered objectionable, but also for many purposes where it will be found more economical than steam, and in others where it will be applied in substitution of manual labour."

WEEKLY LIST OF NEW ENGLISH PATENTS.

Richard Want and George Vernum, both of Enfield, Middlesex, engineers, for an improved steam-engine, which may be also worked by air and other fluids. June 10; six months.

John Miller, of Henrietta-street, Covent-garden, London, gentleman, for a new system of accelerated menattrite locomotion, even by animal expulsion, for every species of transport machines acting by means of wheels, whether on land or water. June 13; six months.

Charles Henry Capper, of Edgbaston, Warwick, gentleman, for a method of preparing and cleaning minerals and other substances. June 13; six months.

Joshua Taylor Beale, of East Greenwich, Kent, civil engineer, for improvements in the construction and arrangement of engines and machinery for propelling boats or vessels on water, with a means of preventing incrustation in the boilers, parts of which improvements are applicable to land purposes. June 13; six months.

William Hunt, of Dodder-hill, Worcester, chemist, for improved apparatus to be used in processes connected with the manufacture of certain metals and salts. June 13; six months.

Sir Henry Hart, Commissioner of Greenwich Hospital, Rear Admiral in our Navy, for improvements in apparatus for preventing what are called smoky chimneys. June 13; six months.

William Chamberlain, jun., of St. Leonards-on-the-Sea, Sussex, for improvements in apparatus for recording votes at elections. June 13; six months.

James Roose, of Darlaston, Staffordshire, tube-manufacturer, and William Haden Richardson, the younger, for improvements in the manufacture of tubing. June 13; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
June 8	1469	Joseph Sayce	Cornhill	Easy morning coat—(the Toina.)
9	1470	George Lander	Cheltenham	Dress-extending zephyr belt.
10	1471	Alexander Hett	Leicester-square, London	Water valve.
„	1472	Robert M'Clay	Liverpool	Refrigerator.
14	1473	John Randolph Remington	Stafford	Farmers' and graziers' portable mill.
„	1474	Richard Garrett	Saxmundham	Thrashing machine.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co. Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1298.] SATURDAY JUNE 24, 1848. [Price 3*d*., Stamped 4*d*.

Edited by J. C. Robertson, 166, Fleet-street.

MESSRS. M'CONOCHIE AND CLAUDE'S IMPROVED STEERING APPARATUS.

Fig. 1.

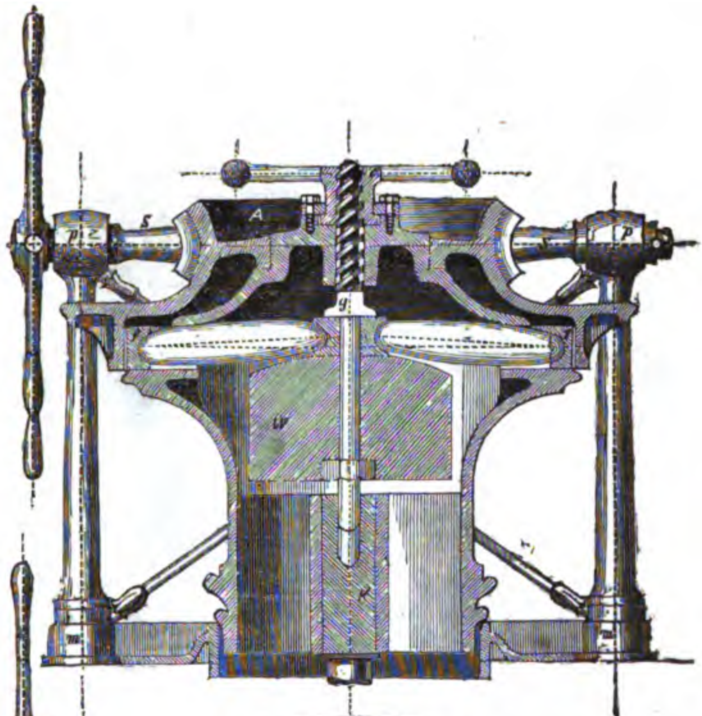
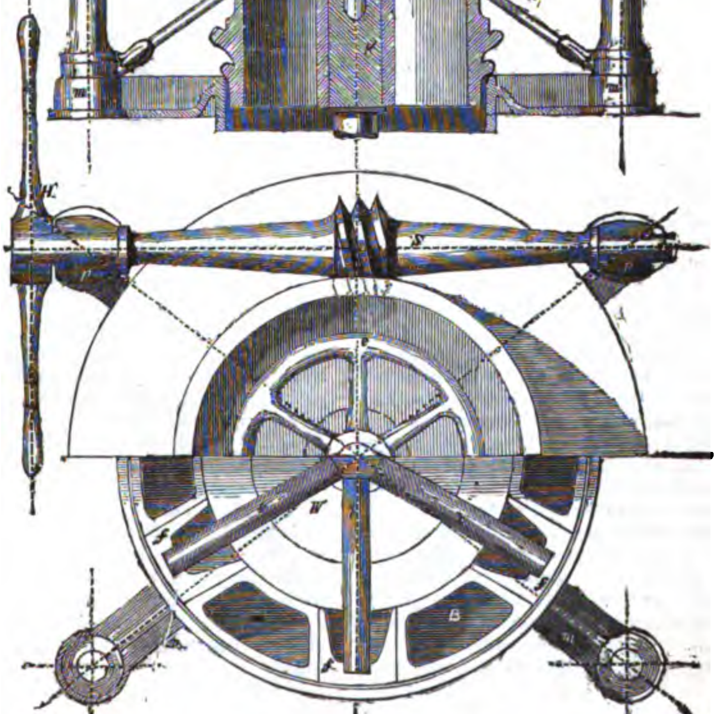


Fig. 2.



MESSRS. M'CONOCHIE AND CLAUDE'S IMPROVED STEERING APPARATUS.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 3.

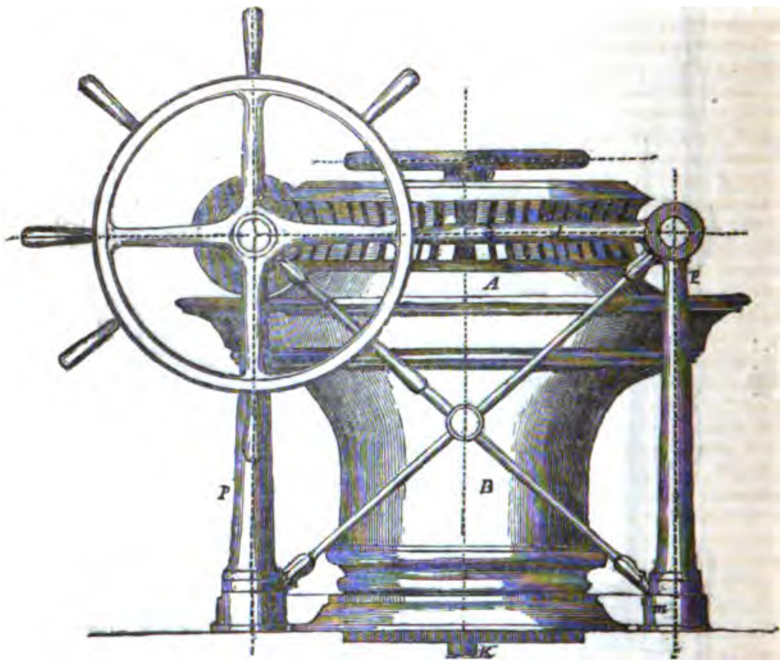


Fig. 1 is a sectional elevation of this apparatus; fig. 2, a plan partly in section; and fig. 3 an external elevation. A is a cast-iron worm-wheel; *f f* are friction blocks working in slots in the head of the pillar B. The blocks are pressed against the inner rim of the worm-wheel, A, by a weight, W, by means of wrought-iron levers, *ff*; *g* is a wrought-iron suspension rod, to which the weight is attached. The ends of the six levers, *ff*, press against sockets in the rod, and on the upper part of it is chased a double-threaded screw, tapped into the wheel, *e*, by the slightest movement of which, the weight may be taken off the friction-blocks, and the pressure removed from the wheel, A, in an instant; but, as soon as the hand is taken from the wheel, *e*, on account of the screw being speedy in its action, the weight, W, falls down, and connects the coupling again. S is a screw, working in the worm-wheel, A, and H is a wheel for the purpose of turning it; *mm* is a cast-iron frame bolted to the deck, and *pp* are pillars cottered into it.

The advantages of this apparatus are,

1st. Gain of power by the introduction of the screw.

2nd. Safety to the man steering.

3rd. Greater accuracy and quickness in steering, from the facility of connecting and disconnecting the coupling. For instance: suppose the helm hard over to port, and that the man in charge of the vessel cries out "steady," instead of bringing the helm amidships by the steering-wheel, H, he breaks the frictional contact of the blocks, *ff*, with B, by a slight movement of the wheel, *e*, and thereby disconnects the coupling; whereupon the helm, from the velocity of the ship through the water, flies amidships; the helmsman then lets go the wheel, *e*, and the rudder is again in immediate connection with the steering-wheel.

ON THE THEORY AND PRACTICE OF SYNTHETIC DIVISION.

Sir,—The general history of scientific discovery shows at almost every page how nearly ingenious men may approach to the discovery of a *principle*, and yet stop short with some mere *practical applications* of it. Thus, whilst they fail to seize the principle, they create a doubt, when the principle is seized by others, whether they had not so closely approached to it as to destroy (in some degree at least) the claim to the honour which belongs to those who at last formally and fully enunciate that principle. Is not this the history, for instance, of the *Law* of Gravitation, and of the *principle* of the Differential and Integral Calculus? It would be easy to give a thousand such instances; and amongst these we have (especially adapted to our purpose,) the two discoveries of Horner:—the principle of Synthetic Division and that of Algebraic Evolution.

It is quite true (as my excellent friend, Professor Young, has remarked in his quotation from his work on "Equations") that to a certain extent, the *praxis* with respect to a divisor of the form $x-a$ was known both to Garnier and Francœur before it was published by Horner in any shape: yet we need only examine the passage quoted by Mr. Wilkinson and the corresponding one of Garnier, to be convinced that neither of these writers connected it with *any theory whatever*; but that they simply obtained the rule from observations made upon the composition of the coefficients of the quotient, as a mere method of arranging the work. I have seen a work on *arithmetic* about a century old, in which the same method was given for dividing by 11 and 9; the name of the author, I am pretty sure, was Wells.* There may also be other approximations to the praxis; but as far as I can find, no one before Mr. Horner had attempted to refer the method to any general principle, nor even to extend the method to any other form than the binomial divisor,—and even then (except in the case of Wells's divisor 11) no one had considered the divisor $x+a$.

Now I suspect that my friend Mr. Wilkinson (No. 1296, p. 574) had casually overlooked the circumstance noticed at the end of Professor Young's note (p. 584) when he expressed his opinion that the method of synthetic division had been previously discovered by Garnier and more fully developed by Francœur. There is certainly nothing to show that the very acute and able French algebraist had even *conceived* the idea of developing

$$\frac{A+Bx+Cx^2+\ldots}{a+bx+cx^2+\ldots}$$

by any methods analogous to that by which he developed

$$\frac{A+Bx+cx^2+\ldots}{a-x}.$$

We have, then, as it appears to me, no more right to say that Horner was anticipated by Francœur, than we have to say that Francœur was anticipated by Wells.

It should also be remembered that the direct application of this process to the case quoted by Mr. Wilkinson is *essentially contained in Horner's "Method of Approximation to the Roots of numerical Equations,"* which was printed in the *Phil. Trans.* for 1819: but the investigation of this special case was then derived from higher algebraical principles than those by which he subsequently developed the general process of Synthetic Division. I possess a Latin MS. of Mr. Horner's on his general method of solving equations, which was completed as far back as 1815; and in this the method is as fully conceived as it was in the subsequently printed paper of 1819. It cannot, therefore, be admitted that Horner was in the slightest degree anticipated by Francœur, even to the extent of dividing by $x-a$. His extension of the principle to divisors of more than two terms, and his giving moreover an intelligible theory of the process:—these constitute what he called his "Method of Synthetic Division," of which indeed the binomial divisor forms only the most confined instance of its application. Still no one but himself had ever contemplated more than this confined instance; at least, as far as my own

* This method was very effectively employed by Dr. Rutherford in his extraordinary computation of the number π by means of Euler's Equation,

$$\frac{\pi}{4}=4\tan^{-1}\frac{1}{5}-\tan^{-1}\frac{1}{70}+\tan^{-1}\frac{1}{99};$$

the $\frac{1}{99}$ being considered, in fact, as $\frac{1}{100-1}$ or more properly as $\frac{\cdot 01}{1-\cdot 01}$.

knowledge of writers on such subjects enables me to discover.

As far, indeed, as Garnier and Francœur are concerned, it is extremely likely that they were guided by the method of Budan for "unit-transformations," in getting to the method of transformation by a units at a time. Budan was a most "persevering plodder," and possessed of much ingenuity; but still his entire work bespeaks mere mathematical experimentalism, and is totally and strangely divested of everything like general views upon the principles of algebra. Yet singularly enough, because Mr. Horner was known to have purchased a copy of Budan's work, *after he had sent his own paper to the Royal Society*, he was charged by Mr. Nicholson with having borrowed his method from that author! It is, indeed, true that the *praxis* of Budan's transformation is included as a very limited case of Horner's general method; but it could never have been inferred by a fair and competent judge in these matters, (even had Horner been in possession of Budan's work from the time of its publication) that *it could have suggested a single idea* towards that ingenious train of investigation by which Horner first developed his method in all its generality. I may safely appeal for the truth of what I affirm to every mathematician who is acquainted with Budan's book and Horner's paper.

I would gladly avoid my next remark did not the circumstances demand it of me. Mr. Nicholson had seen some papers of Mr. Holdred in which an attempt at transformation had been made; and he conceived a modification of the method, which he published in 1822, and which, as far as the praxis is concerned, renders it perfectly identical with that of Francœur for a single figure, and with that of Horner for the continuous process. This led Nicholson to indulge in a series of hostile attacks upon Horner's originality—to one of which, of a most ungenerous nature, I have just alluded. Now, I think it cannot be doubted that had Horner known of the passages in Garnier and Francœur, he would have retorted upon his assailant; for Nicholson's method of establishing *his* (so-called) process, is almost literally copied from the passages referred to by Mr. Wilkinson. This may be accidental, I admit; but the inference to be deduced from Horner's neglecting so overwhelming an argument on the question of Nicholson's claim to originality is, most clearly, that Horner was altogether unacquainted with the writings of Garnier and Francœur. I mention it more with the view of correcting Mr. Wilkinson's suggestion than of urging anything derogatory to the memory of Nicholson, to whom we are under deep obligations for many works of great practical value and importance. Yet Horner is dead too, and justice must be done to him; and this, even at the expense of any man who has attempted to do him wrong.

Less than four years ago a repetition of the investigation of Francœur was produced in a work of considerable pretension, *as an original one;* but that work itself being now "extinguished," further remark upon this subject becomes unnecessary. In fact, all reference to this work would have been superfluous, but for one reason:—that this method was put forth as *an independent one, for the purpose of superseding the Synthetic Division; which the author considers foreign to the subject of Equations.*

There appears to exist some misconception in many minds as to the relation between Horner's method of "continuous approximation," and his method of "Synthetic Division." The latter is a simple and general method of dividing one algebraic function by another, in a much more easy and direct manner than in the ordinary method by which algebraic division is ordinarily performed. The great claims which it possesses to become an integral part of our elementary treatises, are:

1. The facility of its application.
2. The great diminution of labour.
3. The small space occupied by the work.
4. The simplicity of its principles, and the elementary character of its investigation.*
5. The adaptation of its form to other inquiries and operations:—as, for instance, to recurring series, to expansions, to reducing expressions into factorials,† to the resolution of numerical equations, &c.
6. That it constitutes the first of a

* Solutions to the Principal Questions on Hutton's Course, p. 93. Hutton, Course, 12 ed. vol. I. p. 127 and p. 524. "Mathematician," vol. i., p. 74.

† Solutions, p. 295. Hutton's Course, 12th ed. p. 280, vol. i.

series of processes, (as we have every reason to anticipate) by which indirect processes shall be replaced by direct ones, *of a practicable character*. A few such replacements, are indeed, already known (as for instance, the theorem of Leibnitz for an integral,) but the synthetic division is the only one yet discovered which can be called "practicable."

On the other hand, the method of "continuous approximation" is a process by which an equation is successively transformed into others whose roots differ, each from those of the preceding, by the successive figures of one of the roots of the original equation. Almost* every attempt to solve numerical equations that has ever been made, has proceeded on this principle; and the differences of these methods have depended on the means employed to effect the purpose. Mr. Horner arrived, from general considerations, at the method which bears his name quite independently of the method of "Synthetic Division:" but he afterwards observed that the investigation of it might be effected more simply by means of successive divisions; and, then, that by a different arrangement of the numerical work of division (in the synthetic form) the praxis would become identical with that which he had previously devised. The method, and even the work, in all its details had existed anteriorly to the synthetic division; and, except that it would have been less easy of apprehension by a student, it would have been just the same to mathematicians if the synthetic division had not to the present hour been discovered. It is, in truth, no more *an essential part* of Horner's evolution than it is of finite integration or of recurring series. Neither, again, does the *general principle* of synthetic division display itself in this particular mode of its application; for only the very simplest case of its employment is here made, in order to effect our numerical transformations—as has been truly remarked by Professor Young, p. 584. There is nothing whatever in this employment of it, calculated to suggest the general principle; and accordingly we do not find that any analyst has even suspected the existence of such general principle besides Mr. Horner.

* Mr. Weddle's method proceeds upon a different principle; and this is, perhaps, in strictness, the only one that can be instanced.

Had it not been that I believe Mr. Wilkinson's view of some mysterious identity or essential relation between these two processes of Horner's, is shared by most mathematicians who have only casually studied the doctrine of numerical equations, I should scarcely have entered into so much detail in order to show what the relation really is—*viz.*, *one of convenience, not one of essential dependence*. Had I thought his view a solitary one, a private letter to him would have sufficed; but as it is, I am glad that he has proposed his doubts of Horner's originality publicly, and that in a work of such extensive circulation as your own. Nothing can exceed the delicacy with which his suggestion is made; and for this, as well as for his affording me an opportunity of explaining a somewhat misunderstood point in elementary algebra, I beg him to accept my thanks.

T. S. DAVIES.

Royal Military Academy,
June 17, 1848.

NOTES ON THE THEORY OF ALGEBRAIC EQUATIONS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from page 540.)

Second Series. Note D.

The process, which I gave at page 512 of this volume, for the solution of two simultaneous general quadratics of the fourth order is, with the help of a transformation, capable of being applied to the solution of two such equations of the *third* order. Denote (as we may do) the two *tertiary** quadratics respectively by

$$f_1^2(x,y,z)+b_1x+c_1y+d_1z=a_1,$$
$$f_2^2(x,y,z)+b_2x+c_2y+d_2z=a_2.$$

Let $\left.\begin{array}{l}x=x'+x'',\\ y=y'+y'',\\ z=z'+z'',\end{array}\right\}\;\ldots\ldots(\text{I.})$

and, in the given quadratics, substitute for x, y, z their respective values as given by the last three equations, then x'', y'', and z'' may in general† be determined so as to reduce one of the quadratics—the first for instance—to the form

$$f_1^2(x',y',z')=a'_1\;\ldots\ldots\ldots(14.)$$

and the other will then take the form,

* See *Mech. Mag.*, vol. xlv., p. 582, col. 2.

† That is to say, whenever one of the given quadratics represents a surface that has a centre.

$$f_2^2(x', y', z') + b'_2x' + c'_2y' + d'_2z' = a_2 \ldots. (15.)$$

Now, by means of the equation

$$b'_2x' + c'_2y' + d'_2z' = 0$$

let z' be eliminated from (14.) and (15.) and we shall have the two resulting equations

$$f_1^2(x', y') = a'_1,$$
$$f_2^2(x', y') = a'_2,$$

the solution of which may be effected by means of "simple" quadratics.* So, if we were required to solve *three* simultaneous and general quadratics of the *fifth* order,† we might proceed as follows:—

Making,

$$b_1x + c_1y + d_1z + e_1p + g_1q = A_1$$
$$b_2x + c_2y + d_2z + e_2p + g_2q = A_2$$
$$b_3x + c_3y + d_3z + e_3p + g_3q = A_3$$

we may represent the last mentioned three quadratics respectively by

$$f_1^2(x, y, z, p, q) + A_1 = a_1,$$
$$f_2^2(x, y, z, p, q) + A_2 = a_2,$$
$$f_3^2(x, y, z, p, q) + A_3 = a_3.$$

In addition to the three equations (I.) we may assume,

$$\left.\begin{array}{l} p = p' + p'' \\ q = q' + q'' \end{array}\right\} \ldots. (II.)$$

and, by the aid of the five quantities x'', y'', z'', p'', q'' we may in general reduce one of the three given quadratics of the fifth order—the first for instance—to the form

$$f_1^2(x', y', z', p', q') = a'_1 \ldots. (16.)$$

and the other two will take the form

$$f_2^2(x', y', z', p', q') + A'_2 = a'_2 \ldots. (17.)$$
$$f_3^2(x', y', z', p', q') + A'_3 = a'_3 \ldots. (18.)$$

where

$$A_2' = b'_2x' + c'_2y' + d'_2z' + e'_2p' + g'_2q',$$

and

$$A'_3 = b'_3x' + c'_3y' + d'_3z' + e'_3p' + g'_3q';$$

hence, if, by means of the two linear equations

$$A'_2 = 0 \text{ and } A'_3 = 0,$$

we eliminate p' and q' from (16.), (17.), and (18.) we shall have the resulting equations

$$f_1^2(x', y', z') = a'_1,$$
$$f_2^2(x', y', z') = a'_2,$$
$$f_3^2(x', y', z') = a'_3,$$

which may be completely resolved.*

This method of resolving equations of the higher orders may be termed the Method of Homogeneous Elimination.† As we have just seen, we may by means of *transformation* render its application coextensive with that of the Method of Vanishing Groups—at least so far as the simultaneous and general solution of two tertiary and three 5-ary quadratics is concerned. I shall next exhibit concisely a sketch of its further application.

Let

$$f^n (m)$$

denote a homogeneous function of the nth degree, and of m undetermined quantities. Then two simultaneous and general cubics involving m unknowns may be represented thus:—

$$f_1^3 (m) + f_1^2 (m) + f_1^1 (m) = a_1,$$
$$f_2^3 (m) + f_2^2 (m) + f_2^1 (m) = a_2.$$

Now, by a transformation and an elimi-

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* *Vide supra*, p. 512.

† The following transformation and reduction of three quadratics of the fourth order is not uninteresting, and will serve as an illustration of what may be effected on the subject.

Let there be given three equations of the form,

$$f^2(x, y, z, p) = a$$

then, by *transformation*, we may arrive at the system

$$f_1^2(x', y', z', p') + A'_1 = a'_1$$
$$f_2^2(x', y', z', p') \quad = a'_2$$
$$f_3^2(x', y', z', p') + A'_3 = a'_3$$

where $\quad A'_1 = b'_1x' + c'_1y' + d'_1z' + e'_1p'$.

and, $\quad A'_3 = b'_3x' + c'_3y' + d'_3z' + e'_3p'$

Let, for instance,

$$A'_1 + A'_3 = 0 \ldots (a.)$$

and let z'' be what A'_1 becomes when in that quantity we substitute for p' its value derived from (a); then

$$z'' = b''x' + c''y' + d''z',$$

whence z' is given as a linear and homogeneous function of x', y', z'', and, by substituting for z' in the transformed system, we shall obtain the following reduced equations:—

$$f_1^2(x', y', z'') = a_1 - z''$$
$$f_2^2(x', y', z'') = a_2$$
$$f_3^2(x', y', z'') = a_3 + z''$$

a result which would have had a still simpler aspect had we, as we might have done by multiplication or division, made

$$a_1 = a_2 = a_3$$

at starting. We might moreover have rendered each of these last mentioned quantities equal to unity or any required or convenient number.

* *Vide supra*, page 512.

† I have so named the method on account of the eliminations by which we reduce the given equations to the required form, making their right-hand sides numbers and their left homogeneous functions of the unknowns.

nation similar to that employed in the preceding part of this Note, we may put these two cubics under the form

$$f_1^3(m-1)+f_1^2(m-1)=a'_1$$
$$f_2^3(m-1)+f_2^2(m-1)=a'_2,$$

and these again may be reduced to

$$\left.\begin{array}{l} f_1^2(2)=a'_1, \\ f_2^2(2)=a'_2, \end{array}\right\} \ldots \text{(III.)}$$

provided that we can satisfy the simultaneous equations

$$f_1^2(m-1)=0 \ldots (19),\ f_2^2(m-1) \ldots (20),$$

and yet leave undetermined two of the unknowns. By means of the two undetermined quantities remaining, we may then satisfy (III.)* If $m=9$, the two equations (19.) and (20.) can be satisfied in the required manner by the direct application of the Method of Vanishing Groups, or of Mr. Jerrard's Method of Vanishing Coefficients.†

In the same manner two biquadratics of the mth order may be reduced to the forms

$$f_1^4(2)=a_1,$$
$$f_2^4(2)=a_2,$$

provided that, after solving two equations of the form

$$f_1^3(m-1)+f_1^2(m-1)=0 \ldots (21.)$$
$$f_2^3(m-1)+f_2^2(m-1)=0 \ldots (22.)$$

we have two of the unknowns still undetermined. We can always satisfy (21.) and (22.), and leave two unknowns undetermined, provided m be large enough. More remains to be said upon this subject; but I shall not pursue it further here.

In the second solution of a quadratic at p. 518 of this volume, we might (instead of the process there given) have multiplied both sides of the given equation into $4q$, and then have added p^2x^2 to each side of the result.‡

In some remarks at p. 123 of vol. xlvi. of this work*, I must not be understood as saying that Sir W. R. Hamilton has actually mentioned the "type of solution" of equations, but that he has stated that there are no solutions of biquadratics essentially different from those of FERRARI or DESCARTES (*vide supra*, p. 537, note ‡.) I shall perhaps be permitted to give in a note† some rough memoranda upon the subject of biquadratics which I made some time since, and also a remark of ABEL which bears upon the point which I had before my mind at the time.

2, Church-yard-court, Temple, June 2, 1848.

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* Vide *supra*, p. 511.

† There is some analogy between the process of Mr. Jerrard's Method and that employed in solving Diophantine Problems, where I use the term "Diophantine" in its stricter sense.*

* See *Mech. Mag.*, vol. xlvii., pp. 134, 306.

‡ A solution of a quadratic may be presented under the following aspect:—

$$\text{Let } x(x+a)=b$$

$$\text{make } y=x-\frac{a}{2} \ldots (\beta),$$

and we obtain at once

$$y^2-\frac{a^2}{4}=b,$$

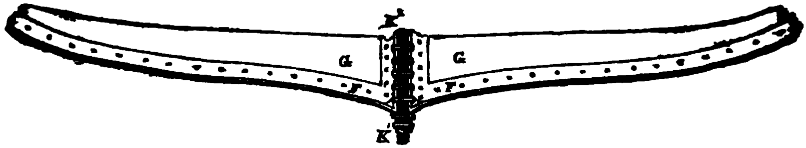
whence y, and consequently x, may be determined. In this case, the very form of the given equation suggests the assumption (β.)

* Left-hand column, lines 41 to 48.

† Memorandum (made probably at the end o 1844 or in 1845) *On the reduction of biquadratic equations to the binomial form.* This is a question to which is attached an interest greater than we should, at a first glance, be inclined to attribute to it. Although not directly connected with the reduction of the equation of the fifth degree to a similar form, or with its solution in any other manner, yet there are considerations which show that its discussion is calculated to throw some light on these latter problems. In none of the known solutions of biquadratic equations does a radical of the fourth order occur [that is to say, no such solution is expressed in terms of irreducible biquadratic surds,] and from the remarks made by [MURPHY and Hamilton] we cannot help inferring that any attempt to reduce the given equation to the above [binomial] form would be futile—and a confirmation of this inference will be found at the last three pages of the Continuation of the Supplement to Part the third of Mr. Jerrard's *Mathematical Researches*, and [at p. 395 of vol. xxviii. of the *Philosophical Magazine* (s. iii.); and see also] p. 305 of Sir W. R. Hamilton's remarks in the Sixth Report of the British Association. I would however suggest, that, although we may not be able, in our attempts to solve the class of problems there treated of, to arrive at results in which the number of values of the radicals involved shall give such a number of values of the final expression (and no more) as is required by the conditions of the original problem, yet we may nevertheless arrive at expressions in which the required values lie and from which they must be *selected*, just as in the equation of the fourth degree the biquadratic radicals [EULER's for instance] are equivalent to quadratic ones [*vide supra*, p. 537, note †.] Now the rules which are to govern us in our selection being thus derived from collateral considerations will be expressed by means of quantities which may possibly give a *transcendental* form to our final results and so enable us to avoid a collision with the views of Hamilton, ABEL, &c.

[The words within brackets have been added to the above memorandum in preparing it for the *Mechanics' Magazine*.

If however the transcendental expression be supposed to be capable of taking an algebraic value or values, we are then in the question of the finite solution of equations driven back to the original difficulty, as will be seen from the following remark



Sir,—Having had some experience in the constructing of iron vessels, I beg to submit a plan which I think would be an improvement on what has hitherto been in use.

You will be fully aware, that the practice in ship-building has always been, to place the floor timbers of the frame across the keel, which is all right and proper enough for ships built of timber. And, it would seem from the practice of those engaged in the building of iron ships, that they have thought the same rule should be observed in building ships of iron—that is, by placing the angle irons across the keel to form the floors of the frame. The properties of iron, however, being so different, it by no means follows that we should adhere to the same rules. The plan I submit for consideration is to form the keel and kelson of plate or bar iron in one or two breadths, from 1½ inch to 2½ inches in thickness, and from 20 to 24 inches deep, and then to form the floors of angle iron in two lengths, and turn the ends of each up the side of the kelson as shown in the prefixed sketch, and connect them together by rivets through the kelson from side to side. The floor plates also will be in two lengths, as per sketch, which being riveted to the floors, the two sides of the ship will be connected together, equally as well as by the old custom. By this plan, also, there will be formed as strong a back-bone as can be desired, and I think far superior to that now in use (as the connection with the keel and kelson and floors now in practice is not very efficient.) Also, by this plan, the two sides are made completely water-tight from each other, and if it were desired, by continuing the kelson upwards with a thinner material, the ship can be subdivided into fore and aft compartments in addition to the thwart ship bulkheads. It will also be much easier to make the cross-section compartments water-tight, with the floors and kelson formed after this plan, than it is by any now in use. And by turning the angle with a round corner at the garboard, as shown in the figure, it will form an excellent water-course fore and aft, from bulkhead to bulkhead. In the sketch, K^1 represents the keel; K^2, the kelson; FF, the floor angle irons; and GG the floor plates.

I am, Sir, yours, &c.,

ROBERT FOWLES.

Lloyd's Register of British and Foreign Shipping, Port of Newcastle. — Office, North Shields, June 5, 1848.

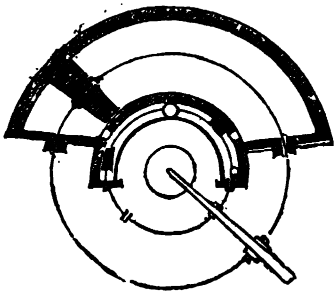
of ABEL, in a paper; "*Sur la Résolution Algébrique des Equations;*" Oeuvres, tome second, pp. 185—209:—

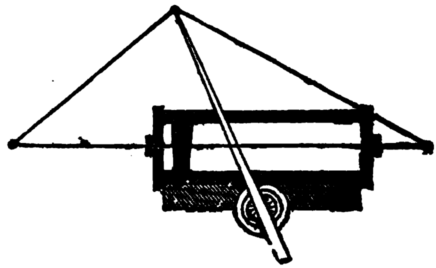
"Si une équation irréductible peut être satisfaite algébriquement elle est en même temps résoluble algébriquement."—Oeuv. tom. 2d., p. 200.

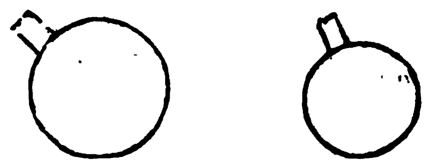
Hence, if the equation of the fifth degree be algebraically insolvible we cannot evade the difficulty by introducing an expression for the root containing transcendants with particular algebraic values.]

MR. SIMS' NEW STEAM-ENGINE.

Sir,—The new steam-engine of Mr. Sims, described in No. 1284, is a most ingenious invention, which I for one the more fully appreciate from having often tried to invent omething of the kind myself, but never succeeded. For the rotary engine I thought of combining the open reaction of the steam, on Barker's water principle, with a weighted piston. I beg to send you sketches of what I had, in 1846, thought of for the reciprocating system. The idea is, combining the motion and weight of the pendulum with the expansive power of steam, and that by doing so, a great power might be obtained with a small expenditure of steam. I think that some ingenious person might carry the plan out, for which purpose these imperfect sketches may be sufficient to show the principle without entering upon the detail, for which I have several plans, but none satisfactory.







These sketches may suggest to others what I aimed at, and enable them to carry out to working, the pendulum engine. The circular rod in fig. 1 is after the plan of Messrs. Bunnet and Corpe's engine. FORRESTER.

June 15, 1848.

ELECTRICAL CLOCKS.

Sir,—Permit me to notice a correspondence which has lately appeared in your pages (between Mr. Hislop and "F. L.," of Bath) on the subject of electric clocks. Neither of these gentlemen seems to be aware that the invention of winding up clocks by electricity is no novelty, or that, in employing such an arrangement, they are infringing a pateut granted to me, Jan. 11, 1841, for "improvements in the application of moving power to clocks and time-pieces." On reference to the specification of my patent (enrolled in the Petty Bag Office, Chancery-lane) it will be seen that I not only wind up the *watch movement* of a clock by electro-magnetism, but the *striking part* also; the other mechanism of the clock being of the usual kind, and regulated by a pendulum, or a balance-wheel, as the case may be.

Another simple method by which I obtained the object sought for by your correspondents, was, to fix the soft iron keeper of the electro-magnet to the free end of a flexible spring, the spring being adjusted to the required strength by a regulating screw. The magnet, the spring carrying the keeper, and the pendulum of the clock, were all fixed to the back of the clock-case, and so arranged, that every time the keeper was released from the magnet, it struck a slight blow against the pendulum-rod, the pendulum being at that instant in a suitable position to receive the impulse. In this manner the pendulum received its impulses from the spring, which were always of the same uniform intensity, however variable the power of the electro magnet might be. This plan, among others, was publicly exhibited at the Polytechnic Institution, Regent-street, in 1842, since which time I have gone on progressively improving the details of electrical clocks, as also the methods of generating the electric fluid for working them, so that this invention has now arrived at that state of perfection that it only requires to be properly understood by horologists, to ensure its universal adoption.

This point has only been attained by great personal application, and at considerable expense; with every disposition, therefore, to allow the utmost

latitude to ingenious experimentalists, I must be permitted to caution them against publicly making, using, or selling of electrical clocks, as that would subject them to the penalties consequent on the infringement of my patent right.

I am, Sir, yours, &c.,

ALEXANDER BAIN.

SEA WALLS—SHOULD THEY BE SLOPING OR VERTICAL?—PROTEST BY GENERAL SIR HOWARD DOUGLAS AGAINST THE REPORT OF THE DOVER HARBOUR COMMISSIONERS.

[Concluded from page 596.]

Article 38.—The works of the Cherbourg Dyke have, for the last fourteen years, been proceeding with activity, in this manner; all the questions of construction which have so long been debated, are now considered as solved and settled; and this practical solution, as to the best profile, far from affording ground for rejecting the slope, or adopting the vertical wall, involves a combination of both, and distinctly shows that a long slope at the lower part is absolutely necessary to resist the action of the sea. With this provision, a superstructure of the upright form, with a fore-slope protecting the re-entering angle, may be built for the purpose of covering the terre-plain behind, and any batteries* erected thereon, which would otherwise be overwashed by waves. These, it has been said, in rushing up the slope, are found to have exhausted their force against the asperities of the material; an effect which cannot be produced by a wall raised vertically from the bottom of the sea. This is admitted† even by those who controvert Mr. Emy's proposition for constructing breakwaters with concave faces.

The above profile is taken from Mr. Virla's work (page 21), from which also I have taken the preceding observations on the circumstances which led to the adoption of a combination of the slope with the vertical superstructure, as the best of all forms that can be adopted for the construction of breakwaters in exposed situations. This combination is very different from the total rejection of the slope; and an inspection of the figures is sufficient to overthrow all that has been advanced respecting the works at Cherbourg being a warning to us to avoid the formation of breakwaters with slopes. On the contrary, they afford demonstrative evidence that such a formation is essential to the stability of such works. Let this combination be adopted in Dover Bay, and the work will proceed, under the sure guide of experience, to a successful termination.

Article 39.—I shall not enter into the controversy between Mr. Emy and his opponents, upon the subject of the concave face versus the plane, whether vertical or inclined, further than to observe, that he has made out a very good case in favour of his proposition for a concave front. It has been executed, as is admitted, with success, on a small scale, in the localities which he has cited. Major Sandham, and other able and experienced engineers, recommend the adoption of the concave face, upon the principle that "it is much better to turn, than to attempt to meet, directly, the irresistible action of water; Mr. Airy is likewise an advocate for walls with upright faces. The learned Professor condemns the work of Mr. Emy as not based upon mathematical principles, and of very little value throughout‡, yet in his Paper (No. 14,

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* I think it right to insert, for the information of the Government, if not for publication with the Report, the accompanying plans and profiles of the dyke and of the central battery, with casemated barrack (beside the batteries at the ends of the Cherbourg Dyke), to which I adverted in the House, when speaking of the necessity of establishing a powerful battery on the west elbow of Plymouth Breakwater. (Not printed.)

† Virla en response à une mémoire publiée par Mons. Le Colonel Emy, 1813.

‡ (Q. 473, p. 37, Minutes of Evidence, Commission of 1845.)—You have stated that you believe generally in the theory promulgated by Emy, the French writer. Are you aware that Mr. Airy, in his late "Treatise on Tides and Waves," states that the theories of De la Coudrey, Bremontier, and Emy are throughout of very little value?—It is probable that the theory may be wrong; but when mathe-

Appendix to the Minutes of Evidence, article 3, page 88 at the bottom) he affirms, that "the construction of a breakwater would be exposed to less danger if the section of the wall presented to the sea were a hollow curve, like the base of the Eddystone Lighthouse." Now this is the very principle which it is the object of Mr. Emy's work to teach and establish. It is also remarkable enough that Mr. Emy supports his opinion by the very same argument as the Astronomer Royal has used, and also illustrates it with a reference to the Eddystone Lighthouse. For that purpose he introduces a figure to show in what manner the sea is turned and thrown up by its action on the concavity of the base; to which there can be no doubt the stability of that important structure is greatly owing.

The arguments brought against the concave face are principally as to the difficulty of execution (with respect to which there is no doubt); but it is admitted by the Institute, and even by Mr. Virla, that walls formed according to Mr. Emy's profile have succeeded better than vertical walls would have done in the cases cited by him, on account of the greater uniformity with which they resist the action of the sea. The concave profile of Mr. Emy was not deemed applicable to the works of Cherbourg, on account of the difficulty of executing it, and it was rejected accordingly; but in the reasonings against Mr. Emy's proposition, we find the most explicit recognition of the advantages, and even the necessity of the long slope, to break and resist the force of the waves before they reach the vertical parapet with which the work is crowned.

In justice to Mr. Emy, I have thought it right to make these observations; inasmuch as questions 154 and 155* refer to the stress I had laid upon Mr. Emy's authority as asserting and proving the inability of upright walls to resist the percussive action of seas and waves, and that inclined planes are less acted upon than vertical walls in proportion as their slopes are longer. Question 154 assumes that the pamphlets of Virla and Duleau contain a full and definite refutation of Mr. Emy's theory; but the Commission should have been aware that Mr. Emy has since given a full reply to those pamphlets*; and it would appear that Mr. Emy's work is, in many respects, held in a degree of estimation here as well as elsewhere, rather different from that which is implied by the questions to which I have referred.

Article 40.—I dissent entirely from the statement made by the Commissioners in their Report (page 9), that they do not approve fully of any of the plans sent in; and I differ from them, for the reasons I have stated, with respect to that to which they give the preference. It appears to me that some of the plans and specifications submitted to the Commission deserve much approbation, and that a selection might be made which should, without further hesitation, be adopted and carried into effect. I have always entertained a strong conviction that if the Commission had, in its session of 1844, after having inspected the coast and examined so many competent witnesses, exercised its own knowledge and judgment in drawing up a brief specification comprehending the outlines of some well-tried, safe, and simple mode of construction, instead of embarrassing itself with a mass of conflicting opinions and theoretical considerations which have led to no practical result, the great work which we so earnestly recommended at that time might at this moment have been in progress; instead of which, the Commission has burthened the government with a quantity of matter from which it is not easy to extract any specific plan, and therefore nothing is done to relieve the Government from the difficulty which induced it to re-assemble the Commission, and again refer to the latter the very question, respecting the mode of construction, which it was originally deemed competent to consider. This proposition they were expected to decide, and in my opinion they ought to have determined it.

Article 41.—I object to the use of blocks of concrete, or of brick set in cement, or to any other artificial material, as substitutes for stone, for the formation of national works, which, if not to be constructed on sound and well-tried principles, with materials of the best and most enduring descriptions, should not be attempted; and I dissent most strongly from the recommendation of a majority of the Commission, for the adoption of masses of brick, as proposed by Mr. Rendel. That proposition is

matical gentlemen reason upon theories, they may equally be wrong. The theories of Bremontier and Emy were founded upon a residence upon this coast, and repeated observations made.

474. What coast did Emy reside upon to see the flot du fond?—He was continually visiting that part of France. I should be rather inclined to take the theories and opinions of practical men who have observed nature with their own eyes, than I would the theory of a closet.

* 154. Great stress has been laid upon Mr. Emy's authority; are you not aware that Emy has received a full answer from Mr. Virla, and also from Mr. Duleau, which has been published upwards of eight years?—I am aware that this theory has been disputed by many people, and with great justice.

155. Are you aware that that is entirely denied as an authority by engineers in France?—I am not aware of that of my own knowledge, but I should consider it very probable.

* "La Commission des Annales des Ponts et Chaussées s'est empressée d'ordonner l'insertion la plus prompte possible de cette response, et de saisir ainsi l'occasion de donner à M. le Colonel Emy une nouvelle preuve d'estime pour ses utiles travaux."

experimental in form, substance, and mode of execution; and to it therefore attaches the objection which Mr. Rendel has so well expressed to all expedients, however ingenious, in executing national works of this description;* and I feel convinced that upon reconsideration of the expense of brick blocks, compared with that of stone, that this judicious, experienced, and hitherto successful engineer, will decline to assume the responsibility of persisting in a project to which, as he must be aware, formidable objections have been made by practical men, and which there is every reason to believe will neither be conducive to economy, security, nor facility of execution.

Article 42.—I dissent, lastly, from any extension of the area to be comprehended by the breakwater, as recommended in our Report of 1844; and more especially from the suppression of the eastern opening. It appears to me that without such opening, the proposed Harbour of Refuge would be deprived of an essential condition which all such harbours should possess, that of facility of egress or escape at all times and tides, and in all weathers; and I am convinced that by omitting to form this opening, the proposed enclosure would become to such a degree a close harbour, as greatly to increase and accelerate the progress of the evil to which all close harbours are liable, that of rapidly silting up.

Article 43.—This dissent, far from being occasioned by any alteration in the views and opinions which led me to concur, most cordially, in the recommendation of the Commission in 1844, that a Harbour of Refuge be constructed in Dover Bay, proceeds, on the contrary, from an anxious desire to see that great work undertaken forthwith, in a well-tried and sure mode, and with materials of the most enduring quality. In this manner only will it be possible to disarm the objections that may, and I think will be made, to entering on a work of this magnitude, cost, and national importance, on any plan which has not already been tried on a sufficient scale, and for a sufficient length of time, to warrant its adoption; particularly as this is a case where failure would be in the highest degree prejudicial to the public interests.

HOWARD DOUGLAS,
Lieutenant-General.

* Mr. Rendel's opinion on Captain Vetch's iron caissons. Mr. Rendel, on Captain Denison's very ingenious proposition (Q. 382, p. 30 of Report, Minutes of Evidence, Nov. 26, 1845), says: "I have never seen more ingenuity than in all the arrangements which Captain Denison proposes; but in my experience I have found that nothing is more troublesome to a man than his own ingenuity; it frequently gives him more trouble than he would have had in the ordinary way of doing things."

THE AMERICAN PATENT SYSTEM.—REPORT OF THE AMERICAN COMMISSIONER OF PATENTS FOR 1848.

Patent Office, January, 1848.

[We think we cannot better promote the much-desired reform of the patent laws of our own country than by showing how a kindred people thrive under a different and better system. The points most deserving of attention in this report are; *first*, the much greater number of patents applied for and granted in the United States than in England, arising, manifestly, from the cost being so much less; *second*, the liberal and judicious proposition of the commissioner, to place aliens on the same footing as natives in regard to cost—every alien being at present required to pay as much for an American patent as he would for one in his own country; and, *third*, the appropriation of the entire revenues of the Patent-office, to the promotion and protection of the interests of those from whom they are derived.—ED. M. M.]

Sir,—In compliance with the provisions of the act of Congress, entitled "An Act in addition to the Act to promote the progress of science and the useful arts," approved March 3, 1847, the undersigned has the honour to submit his annual report.

During the year ending December 31, 1847, the whole number of applications for patents, is 1531. The whole number of caveats filed during the same period is 533.

The number of patents issued in 1847 is 572, including 14 re-issues, 3 additional improvements, and 60 designs; classified and alphabetical lists of which, with the names of the patentees, are annexed, marked K and L. Three disclaimers were, during the same time, entered.

Within the same period, 580 patents have expired; a list of which is annexed, marked M.

There were during the year 9 applications to extend patents about to expire, 6 of which were rejected and 3 granted by the board, established by the Act of July 4th, 1836, to hear and determine that class of applications.

The claims embraced in the respective patents issued during the year 1847, are also annexed, marked P.

The number of applications for patents examined and rejected during the year 1847, is 557; being very nearly as many as were granted. Many of the rejected cases may, however, be reconsidered, and, perhaps, upon further examination, passed, and patents issued for the inventions or improvements claimed by the applicants.

The receipts of the office during the year 1847, including duties and fees paid in on

applications for patents, caveats, re-issues, disclaimers, additional improvements, extensions, and for copies, amount, in the whole, to 63,111 dollars, 19 cents; of which sum 8,008 dollars, 43 cents have been repaid on applications withdrawn, and for money paid in by mistake, as per statement marked A.

The expenses of the office, during the year 1847, for salaries amounted in the whole, to the sum of 33,559 dollars, 92 cents, as per statement marked B.

There was also expended during the last year, under the act of March 3, 1837, for the restoration of records and drawings, the sum of 310 dollars, as per statement marked C.

The aggregate of expenditures under the different heads above enumerated, is 41,878 dollars, 35 cents; leaving a balance, to be carried to the credit of the patent fund, of 21,232 dollars, 84 cents.

On the first day of January, 1847, the amount of money in the treasury, to the credit of the patent fund, was 186,565 dollars, 14 cents; which, with the balance paid in during the year 1847, will, on the first day of January, 1848, amount to the sum of 207,797 dollars, 98 cents.

It will be seen, that the surplus carried to the credit of the patent fund, during the last year, is much greater than that of any former year. This arises from two causes; first, the great increase of applications for patents and caveats over any former year; and, secondly, the inability to examine and decide upon applications in a reasonable time after they have been filed in the office, growing out of the inadequacy of the examining force of the office, causing a comparatively less number of withdrawals, and a comparatively less amount of expenditure for copying and recording patents. If Congress should authorise an increase of the scientific corps, so imperatively needed, the number of withdrawals will be greater, and the other expenses of the office will be increased, and thus the balance next year will be, in all probability, much smaller than it is this year.

All moneys paid into the treasury on account of the Patent-office, are set apart by the ninth section of the Act of July 4, 1836, and the fourteenth section of the Act of March 3, 1837, for the benefit of the Patent-office, and denominated the patent fund; out of which all expenditures provided by existing laws are to be paid, the patent fund being especially appropriated for that purpose. By thus establishing the patent fund, and appropriating it to the special object of defraying all expenditures of the Patent-office authorized by law, Congress expressed its intention to constitute the office upon the principle of a self-sustaining institution, which is to exist upon its own revenues, and not depend for support upon the general treasury. Thus far, it gives me pleasure to say, the intention of Congress has been fully carried out, the office having not only paid its own expenses from its own revenues, but it has accumulated a comparatively large balance in the treasury to its credit. With the exception of the cost of erecting the present Patent-office building, to which the office contributed 108,000 dollars from its own funds, it has never been a charge upon the treasury.

Nearly all of its revenues are derived from inventors. It is sustained by their contributions; its services are appropriated to the promotion of their particular interests, although rendered to all other interests when required; and it may, therefore, truly be regarded as the head and representative of the inventive genius and the industrial arts of the country.

The annual reports of the two principal examiners, addressed to the undersigned, giving a view of the inventions and improvements which have passed their respective desks are annexed, marked D and E.

To these two important reports attention is particularly called. They give an interesting summary of the scientific operations of the office during the past year, thus presenting in a small space the most conclusive and gratifying proofs of the progress of our countrymen in the improvement of the useful arts. It will be seen from the two papers referred to, that the year just past has been fruitful of inventions of a most important and valuable character, if they have not been of that novel and brilliant description which sometimes surprise and startle the world, at the same time benefitting it by their great utility.

The peculiar circumstances of society in this country, growing out of its settlement —very recent when compared with the age of other civilized portions of the earth, and imposing the necessity of subjugating the forest, of smoothing down the rugged face of nature, and of planting upon its bosom the arts of industry, which have rapidly germinated and developed themselves into great and important interests, now flourishing with a vigour and energy which enable them to become the formidable rivals of similar interests of older nations — have tended to stimulate the inventive genius of our people to the production and improvement of machines and processes of an utilitarian and labour-saving character, rather than to the pursuit of more scientific discovery. Hence, while we may be behind other countries in the discovery and development

of scientific principles, we are probably equal with, if not in advance of them, in their application to the useful purposes of life. But, if the genius of our countrymen is not now so much absorbed in the investigation of abstract science as that of the citizens of older and more opulent countries, the circumstances of society so rapidly improving by the steady tide of prosperity which sets in our favour, will soon place us in a condition to contribute our share to the sum of knowledge which the combined genius and labours of the learned of all civilized nations annually bestow upon mankind.

It will also be seen, on reference to the reports of the examiners above referred to, that the labours of those two officers are of a very varied and complicated character, embracing in their range the whole field of invention, and requiring a thorough knowledge of every branch of science, as well as the state, past and present, of the arts in all countries. From this fact the talents and attainments requisite for the able discharge of the duties appertaining to their desks may be readily inferred. It may be safely assumed that there is no office in the government, the duties of which are of a scientific nature, which requires more mental capacity, or more close and intense application, than that of examiner of patents. It would, therefore, be reasonable to suppose that there would be attached to that office a salary commensurate with its duties and the talent and attainment which it requires. But, so far from that being the case, the examiners now receive but 1500 dollars per annum, a sum paltry in comparison with the abilities and qualifications which they must possess—very much below the salaries paid to persons filling stations requiring scientific attainments of an inferior grade, and only equal to the common clerkships in the offices of the Capitol, and the weighers, measurers, and gaugers of the Custom Houses. My predecessor, in his last report, called the attention of Congress to the inadequate salaries allowed to the examiners in this office, and respectfully recommended an addition to be made to that branch of its service. In the two reports which I have had the honour to submit to Congress, I have expressed my concurrence in the recommendations of my predecessor; and from the action which has already taken place in the two branches of that honourable body, I am encouraged to hope that it will not be long before justice is done to that valuable class of officers, whose merits and claims I now again commend to its favourable consideration.

The necessities and embarrassments under which the office is now labouring on account of the want of an adequate scientific force to perform its greatly increased business, impose upon me the duty of earnestly but respectfully soliciting the prompt action of Congress for its relief. A brief statement of facts will show the absolute necessity of an addition to its scientific corps.

By the Act of July 4, 1836, reorganising the Patent-office, the Commissioner of Patents was allowed by a single examiner. By the Act of March 3, 1837, he was authorised to appoint another examiner. And by the Act of March 3, 1839, he was authorized to appoint two assistant examiners. Thus, within a period of less than three years from the reorganization of the office, there were two principal and two assistant examiners provided for by law; since which time no addition has been made, because none has been authorised.

In 1840, the first entire year after the last addition to the examining corps was provided for, the number of applications for patents was 765, the number of caveats filed was 228, and the number of patents granted was 475.

During the year 1847, the number of applications for patents was 1,531, the number of caveats filed was 533, the number of patents granted was 572, and the number of applications rejected was 557.

Thus it appears that the business of the office has increased *one hundred per cent.* since the last addition was made to the examining corps in 1839.

In the year 1844, the year preceding my appointment to the office of commissioner, the number of applications for patents was 1,045, and the caveats filed 380. In 1845, the number of applications was 1246, caveats 452. In 1846, the number of applications was 1,272 caveats 448. And in 1847, as before stated, the number of applications was 1,531, caveats 572. Thus since my appointment to the office of Commissioner of Patents, the business of the office has increased in the ratio of 33 per cent.

During the five years, commencing with 1840, and ending with 1844, embracing the five last years preceding my appointment to the office of commissioner, the amount paid into the treasury to the credit of the patent fund was 25,200 dollars, 43 cents. During the three years since my appointment, the amount paid into the treasury is 37,018 dollars, 72 cents; showing an increase of surplus over expenditures in a much greater ratio than 33 per cent.

In 1844, the business of the office was quite equal to the ability of the examining corps to perform it, and in anticipation of the early necessity of an addition to that branch of the service of the office, my predecessor in his last annual report suggested that such addition would soon be required.

During the last three years it has far transcended the capacity of the examiners to do it as it should be done, or to do it at all, and hence it has accumulated until it has produced serious embarrassment to the office, and very great injury to the interests of the inventors. The office is now seven or eight months in arrear of its business, and is daily becoming more and more embarrassed.

In view of the increasing accumulation of business and the consequent embarrassment of the office, I called the attention of Congress to its condition and recommended an immediate addition to its scientific corps in my report of January, 1846. Before the close of the session of 1845-6, anticipating from the great amount of more important business then pending before Congress, that the necessities of the Patent-office might be overlooked, I again called the attention of Congress to the subject by a letter addressed to the Committee on Patents of the Senate, dated June 10, 1846. Congress, however, adjourned, without taking any action for the relief of the office.

In my report of January, 1847, I again repeated my request for an addition to the examining corps, pressing in urgent but respectful terms the embarrassments of the office growing out of its increase of business, and the *absolute necessity* of the adoption of suitable provisions for its relief. The session being about to close, without, as I apprehended, any action for the relief of the office, I again brought its embarrassments and necessities before both Houses of Congress by duplicate letters addressed to their respective committees having the interests of the patent office in charge, dated February 17, 1847. At that session a Bill passed the House of Representatives providing, among other things, for an addition to the examining corps; but failed in the Senate for want of sufficient time to act upon it.

The embarrassments of the office continuing, and greatly increasing in consequence of its rapidly-accumulating business and the want of an adequate force to execute it, at an early day after the commencement of the present session, and in anticipation of my annual report, I again, by a duplicate letter addressed to the Committees on Patents of the House and Senate, dated December, 1847, respectfully but earnestly requested the interposition of Congress for the relief of the office, by providing for an adequate increase of its examining corps.

Thus have I, in five separate communications to Congress and its appropriate committees within the last two years, made full expositions of the embarrassed condition of this office growing out of its greatly increased and increasing business, and the inadequacy of its force to perform its duties.

In view of these facts, I am confident that the Patent-office cannot be held responsible for the embarrassments and delays which exist in one of the branches of its service. I am conscious that the inventors, by whose contributions this important institution is sustained, have grievous cause of complaint on account of the disappointments and injuries which they suffer from the delays which their business is compelled to encounter in the Patent-office, but I am confident their enlightened liberality will appreciate the earnest and persevering efforts which have been made by the undersigned to remove the just causes of their complaints, and that they will patiently wait the action of Congress for their relief, which, it is gratifying to know, may be confidently anticipated before the close of the present session.

In my former reports I have recommended a change in some of the features of the Patent law as it now exists. For the nature of those recommendations, and the reasons on which they are founded, I would respectfully refer to the annual reports of this office, for 1845 and 1846. In my judgment the changes proposed are necessary to give adequate security to that valuable and meritorious class of our citizens engaged in inventive pursuits. As the law now is, the remedies which it affords to patentees are, in most cases, inadequate to the protection of their rights and the prevention of infringement upon them by that unscrupulous and unprincipled class of persons, who make it a practice wilfully to depredate upon patent rights, and who, from the basely criminal character of the offence which they commit, are stigmatized by the application to them of the infamous epithet of *pirate*. Certainly, adequate protection should be given to the honest inventor who devotes his substance and his incessant toil for the benefit of society, against the freebooters who invade without scruple his property, which, to him, is more sacred and invaluable, because it is the cherished creation of his own genius.

Unfortunately, property in patent rights is not generally looked upon by society in the same light in which property existing in other forms is regarded. This results, perhaps, from the fact that many useless inventions have been patented, by which the public have been imposed upon and deceived. If such be the fact, it does not in any respect affect the general principle upon which not only property in inventions, but all rights of property, are founded.

Nobody doubts the right of property

which a man has in his lands, houses, or common chattels; and all agree that he has a right to claim from the government under which he lives, protection in the enjoyment of his property. Nay, so careful is the government itself of the sacred right which every citizen has in his own property, that it never takes it from him without giving him an adequate compensation for it. The necessities of the government are, in certain emergencies, supreme over the rights of its citizens, and, by virtue of its right of eminent domain, it can take the property of its citizens for the public use. But in all civilised countries, in which the immutable principles of morality and justice prevail, governments never take the property of their citizens and appropriate it to their own use, without first giving an adequate compensation for it. This sacred immunity from unjust invasion of private rights, even by the sovereign power of the state, is secured in all the constitutions, national and state, of this confederacy. They recognize the inviolability of private property, and provide that it shall be taken only for the public use, and then only upon the condition of an adequate indemnity to be first awarded and paid.

It is upon this very principle that the law is founded which provides that property in patent rights shall, on certain conditions, pass from the inventor into the possession of the public, after the lapse of a fixed term of years. Our whole patent system, having its origin in the constitution itself, is built upon the recognition of this absolute right of the inventor to the exclusive enjoyment of the productions of his combined genius, labour, and capital. It regards such a description of property as the law does all other descriptions, as sacred and inviolable, in the possession and enjoyment of which the owner has a right to claim protection. But it subjects it, as it does all other descriptions of property, to the necessities and uses of the body politic, on the return of a fair and just equivalent.

The inventor having the sole control over his invention, may use it in secret if he pleases. He is not bound to disclose it to the public, and the public has no right to its use except by purchase, unless he should voluntarily surrender it. If the community should get the possession of an invention in any other way, it could only have surreptitiously obtained it. Hence, in order to induce him to disclose it, and to permit the public ultimately to enjoy it in common with himself, the government, representing the community, offers him the exclusive enjoyment of his property during a term which it supposes will be sufficient to enable him to obtain from its sale to others, an ample remuneration for his time and expenses in producing it. Therefore, upon strict principles of justice and equity, he is entitled to complete protection in the enjoyment of his rights during the term limited, and if he is not thus protected, the contract is in effect broken on the part of the government; and if such a contract, expressed or implied, existed between man and man, it would, if thus broken, be declared a nullity, and the inventor would be remitted to the enjoyment of his original rights, or exemplary damages by way of compensation would be given to him. And this system is just and equitable to the inventor as well as to society.

There are ample reasons why private and exclusive property in inventions should cease, and the inventions themselves become a part of the common property of the national body politic. If it were not the case, but, on the contrary, if the inventor and his representatives were to be protected in the perpetual enjoyment of his discovery, improvements in a great measure would cease, and advancement in the arts and manufactures would be greatly retarded, to the detriment of the best interests of society.

Therefore it is necessary and just that discoveries, inventions, and improvements in science and the useful arts, should, under proper circumstances, be taken from the inventor and appropriated to the public use, upon the condition that the proprietor shall be justly remunerated for this surrender of his private rights for the benefit of the paramount interests of the community. Hence, while recognizing his absolute right of property in his invention, and promising him protection in the enjoyment of it, as other citizens are protected in the enjoyment of their property, subject always to the superior necessities of the public interest, the patent system provides that the patentee shall enjoy the exclusive monopoly in the use and sale of his invention for the term of fourteen years. It supposes that he will be adequately remunerated for his invention in that space of time, and that at the end of it, it will be just and equitable that his property in his invention should cease, and that it should pass into general use. It adopts this mode of compensating him for the appropriation of his private rights to the public use, instead of appraising the value of his invention, and awarding to him a specific sum in money for it, as is done in the public appropriation of other descriptions of property. And there can be no doubt that this is the best and wisest method that has yet been devised to compensate the inventor; best for him, and best for the public. As

his compensation depends upon his own efforts, he makes every exertion to perfect his invention, and to introduce it into general use during the term to which his exclusive right is limited. Thus does this wise policy benefit both the inventor and society.

But while his exclusive property in his invention exists, it must be conceded that the inventor has a right to demand of the government the most ample security and protection in its enjoyment. This security and protection he does not, under our present imperfect system, enjoy. On the contrary, the difficulty and expense, and the absolute impossibility, in some cases, of vindicating his rights, have rendered the present laws enacted for his protection almost absolute nullities. To remedy this imperfection in the existing system is the object of the amendments of the patent laws, proposed in the two former reports of the undersigned.

While the steam engine, most potent of all the creations of genius, is daily coursing before our eyes, wafting as upon the wings of the wind its precious freight of human life, and its countless treasures of industry and commerce; while the mysterious telegraph speeds our thoughts with the swiftness of lightning which is its obedient and trusty messenger; while magnificent manufactories stud our land, stunning but delighting us with the never-ceasing movement of their wonder-working machinery, it seems unnecessary to remark upon the incalculable value of the labours of the inventor and his claims upon society for protection in the enjoyment of his just rights. And, sooner or later, the undersigned is confident they will be fully recognised and protected by the enlightened legislators of a great republic, whose progress has been so much accelerated by their genius and enterprise.

In my last report, I had the honour to suggest the propriety of reducing the duties now exacted from foreign applicants for patents to the same rate of duty required of American citizens, when it should appear that the governments to which such foreign applicants belonged had made corresponding reductions in the charges and fees now imposed upon the applications of citizens of this country for patents granted within their respective jurisdictions.

Upon more mature reflection, I have arrived at the conclusion that the interests of this country would be best promoted by reducing the duties on all foreign applications to the same amount now required of its own citizens.

In the first place, no such invidious distinction is made by other governments between the application of their own subjects and those of American citizens. It is indeed true, that the duties charged for patents by most of the governments of Europe are very high compared with those charged by the government of the United States upon its own citizens. But the same duties are charged by foreign governments on all alike, whether native or foreign, without any discrimination in favour of one or the other. This policy is liberal and enlightened, and worthy of emulation by a great and generous nation; a characteristic which, it is hoped, may be always justly claimed for the United States.

But, if high and magnanimous sentiments of justice are not sufficient to induce the repeal of the unjust discriminations which our laws make and enforce against foreign inventors, and it is necessary to appeal to the lower and less respectable considerations of self-interest, it may, I think, be clearly shown, that this country would derive from it a benefit infinitely transcending the paltry revenue which it derives from the foreign inventions which are patented here. The great expense which attends the procuring of patents in most of the governments of Europe, and particularly in Great Britain, prevents the patenting of many valuable inventions which are never voluntarily made public, but are used in secret at home, and, of course, rarely become known in other countries. If our laws permitted the patenting of such inventions on the same terms on which patents are granted to American citizens, many of those inventions would find their way into use in this country. More of the valuable inventions which are deemed worthy of patents abroad, even at the great expense on which they can only be obtained, would be patented and introduced into use here. The great extent of our territory, its growing population, and its rapid increase of wealth, offer promises of reward to the foreign inventor which can be found in no other country. To induce him to come here, we have only to place him upon the same footing, and to grant to him the same privileges, which our own countrymen enjoy. We should, by such a wise policy, increase our means of emulating and rivaling other nations in the arts and manufactures.

Nor would it be injurious to our own citizens engaged in inventive pursuits, for it fortunately happens, that there is no competition or conflict of interest among inventors, each exploring a new and untried field of experiment, and each aiming to discover principles and combinations which have never been before known.

During the year 1847, there were but twenty applications for patents from foreigners, upon which the aggregate sum of 8,000 dollars was paid into the treasury. Of

course, if they had each paid but the sum of 30 dollars, the fee charged upon applications of citizens, the sum would have been but 600 dollars. To supply the deficiency in the revenues of the office, which will be occasioned by the change proposed in reference to foreign inventions, it would be necessary to look to other sources than those at present provided. The sum of 3,000 dollars could be obtained by authorizing the charge of a moderate fee for recording assignments; a service which the office now performs, without compensation, for a class of persons a great majority of whom are the last to be exempted from contributing to its support. A much larger sum might be obtained by a repeal of that provision of the law which authorises a repayment of twenty dollars on the withdrawal of an application for a patent that has been rejected, which would operate beneficially to the Patent-office and to the public, by preventing many applications for inventions of doubtful utility and value. A very considerable increase of foreign applications might also be reasonably anticipated, which would contribute to supply the deficiency occasioned by a reduction of the present duty charged upon such applications. Thus, from all these additional sources of revenue, the office would not only sustain itself, but would be able to add to its vigour and efficiency of action as the increase of its business might require.

It is hoped that these considerations may induce Congress to deliberate, and favourably to act upon the proposition for a change of the existing law, in relation to foreign inventions, which is now respectfully submitted.

The rapidly increasing number of applications for patents afford convincing proof of the wisdom and sound policy of the present patent system of the United States. The very low terms on which patents can be obtained in this country, when compared with the cost of obtaining them under most other governments, encourage attempts at discovery and improvement, not only in the higher branches of the arts, but also in the most humble. Hence, the inventive mind of the country is busily at work in all its various grades, daily bringing forth valuable improvements, and contributing to the means of comfort and enjoyment in all the ranks and conditions of social life. This office, standing in a positon from which it can contemplate the whole field of discovery, can mark, from year to year, the great progress of our countrymen in the sciences and arts, and their application to the varied industrial pursuits in which our people are engaged.

Nor is the genius of our countrymen confined to the invention and improvement of valuable machines and processes of manufacture. Stimulated by our present imperfect law of designs, their attention and efforts are turned to the production of the beautiful in form as well as the valuable in use. This result is daily becoming more and more visible in numerous articles and manufactured fabrics, the designs and patterns of which are now patented under the law of designs. Hence, it encourages the hope that our countrymen will soon be able to compete with the ingenious artizans of other countries, in those fabrics and manufactures which not only require a high state of perfection in machinery, but also the production of those beautiful and pleasing forms, figures and designs, which adapt and recommend certain kinds of manufactured articles and fabrics to the taste and fancy of the consuming portion of the community.

* * * *

I have the honour to be, very respectfully,
Your obedient servant,
EDMUND BURKE,
Commissioner of Patents.

To the Hon. R. C. WINTHORP,
Speaker of the House of Representatives.

COOPER'S "CAPTAIN SPIKE'S" MODE OF RAISING SUNKEN SHIPS.

Sir,—A dispute has arisen among a circle of friends about an incident related in the last work of Mr. Fenimore Cooper, namely, "Captain Spike; or, the Islets of the Gulf." Capt. Spike commands a brig, and is riding among the Tortuga Islets, with a Mexican schooner close at hand, on board of which Spike is to put his cargo of gunpowder, when the schooner is suddenly capsized during a tornado. Spike is afterwards very desirous of raising the schooner, in consequence of her having a large amount of Mexican doubloons on board.

The enclosed extracts will put you in possession of the facts as to the mode adopted by Spike for raising the vessel, and we are agreed as to those facts.

One of my friends, whom I shall dub for the nonce, "Nautious," says, "That Spike could not take the strain off the purchases by boring holes in the bow or stern as described in the work—that every purchase was so taut that no further heaving thereon could be made—that there being an inch of water over the combing of the main hatch, the water must of necessity have found its own level—that it would be as high outside,

as inside, and therefore that the carpenter could not have drawn water from the bow or stern."

"A Landsman," on the other hand, while he admits, "that water will find its own level," contends, "that Spike *had by* HIS PURCHASE *raised the vessel so high above the level of the water on the outside, that the water* INSIDE *the vessel was* HIGHER *than that on the* OUTSIDE, and therefore the strain could be eased off the purchases by boring holes fore and aft as described in the Extracts, notwithstanding that the water remained over the main hatch one inch in depth;" and he further contends, that "the water could have remained over the main hatch, because of the sheer, and because there may have not been any outlet for it; there is nothing said of scupper holes, and it is not likely that there were any in a schooner of her size and build.

If, therefore, Sir, you will be kind enough to take this letter into your consideration, in connection with the enclosed extracts, and report your opinion upon it, you will oblige myself and many others who have taken an interest in this question, which has been long discussed among us.

I cannot properly call myself a subscriber to your Magazine—I feel I should say this much in common candour—but I read it, and many of my friends are subscribers, and have merely made me their mouthpiece.

I am, Sir, your obedient servant,

"A LANDSMAN."

Extracts from Mr. Fenimore Cooper's work of "Captain Spike, or the Islets of the Gulf." (First Volume.)

"Captain Spike moved his brig (p. 281) the *Swash*, and moored her, head and stern, alongside the wreck (p. 282.) An anchor was carried out on the offside the *Swash*, and dropped at a distance of about 80 fathoms from the vessel's beam. Purchases were brought from both mast heads of the brig to the chain of this anchor, and were hove upon, till the vessel was giving a heel of more than a streak, and the cable was tolerably taut. Other purchases were got up opposite, and overhauled down, in readiness to take hold of the *schooner's* masts. The anchor of the schooner was weighed by its buoy rope and the chain, after being rove through the upper or opposite hawse-hole, brought in on board the *Swash*. Another chain was dropped astern, in such a way, that when the schooner came upright it would be sure to pass beneath her keel some six or eight feet from the rudder. Slings were then sunk over the mastheads, and the purchases were hooked on. Spike then brought one of his purchases to the windlass and the other to the capstan (p. 283,) though not until each was bowsed taut by hand; a few minutes having brought the strain so far on every thing, as to enable a seaman like Spike to form some judgment of the likelihood that his preventers and purchases would stand. Some changes were found necessary to equalize the strain, but on the whole, the captain was satisfied with his work, and the crew were soon observed to 'heave away; the windlass best.'

"In the course of half an hour the hull of the vessel, which lay on its bilge, began to turn on its keel, and the heads of the spars to rise above the water. This was the easiest part of the process, all that was required of the purchases being to turn over a mass which rested on the sands of the bay. Aided by the long levers afforded by the spars, the work advanced so rapidly that, in just one hour's time after his people had begun to heave, Spike had the pleasure of seeing the schooner standing upright alongside of his own brig, though still sunk to the bottom. The wreck was secured in this position, by means of guys and preventers, in order that it might not again cant, when the order (p. 284) was issued to hook on the slings that were to raise it to the surface. These slings were the chains of the schooner, one of which went under her keel, while for the other the captain trusted to the strength of the two hawse-holes, having passed the cable out of one and in at the other, in a way to serve his purposes, as has just been stated."

Page 284.—"The object to be achieved was to raise a vessel with a hold filled with flour and gunpowder, from off the bottom of the bay to its surface. As she (p. 285) stood, the deck of the vessel was about six feet under water, and every one will understand that her weight, so long as it was submerged in a fluid as dense as that of the sea, would be much more manageable than if suspended in air. The barrels, for instance, were not much heavier than the water they displaced, and the woodwork of the vessel itself was, on the whole, positively lighter than the element in which it had sunk. As for the water in the hold, that was of the same weight as the water on the outside of the craft, and there had not been much to carry the schooner down besides her iron, the spars that were out of the water, and her ballast. This last, some ten

or twelve tons in weight, was in fact the principal difficulty, and alone induced Spike to have doubts about his eventual success."

* * *

Page 285.—"The weight was found quite manageable so long as the hull remained beneath the water. (p. 286.) The schooner was being lightened by getting the other anchor off her bows and throwing other objects overboard. By the time the bulwarks reached the surface, as much was gained in this way as was lost by having so much of the lighter woodwork rise above the water. As a matter of course, however, the weight increased as the vessel rose, and more especially as the lower portions of the spars, the bowsprit, boom, &c., from being buoyant assistants, became so much dead weight to be lifted.

* * *

"It was felt that the resistance now increased as it advanced, and that it was more difficult to gain an inch than it had been at first to gain a foot. They seemed now to be heaving their own vessel (p. 287) out, instead of heaving the other craft up, and it was not long before they heard the *Swash* heeling over towards the wreck several streaks. The strain, moreover, on everything became not only severe, but somewhat menacing. Every shroud, back-stay, and preventer, was as taut as a bar of iron, and the chain cable that led to the anchor planted off a beam, was as straight as if the ship was riding by it in a gale of wind. One or two ominous surges aloft, too, had been heard, and though no more than straps and slings settling into their places under hard strains, they served to remind the crew that danger might come from that quarter.

* * *

"The schooner's precise position was this —having no cabin windows, the water had entered her, when she capsized, by the only four apertures her construction possessed. These were the companion-way or (p. 288) cabin doors, the skylight, the main hatch, and the booby hatch, which was the counterpart of the companion-way forward. The 'combings' of these hatches were six or eight inches above the deck.

"As soon, therefore, as these three apertures, or their combings, could be raised above the level of the water of the basin, all danger of the vessel's receiving any further tribute of that sort from the ocean, would be over.

"This was one end to be attained.

"The schooner possessed a good deal of 'sheer,' that is, her two extremities rose *nearly a foot above her centre when on an even keel*. (p. 289.) This, consequently, brought her extremities first to the surface. The deck forward, as far aft as the foremast, and aft as far forward as the centre of the trunk, or to the skylight, was above the water, or at least awash; while all the rest of it was covered. In the vicinity of the mainhatch there were several inches of water; enough, indeed, to leave the upper edge of the combings submerged by about an inch. To raise the keel by that inch was too dangerous to attempt, considering the strain upon the purchases."

The plan for effecting this was tried as follows:

"It must be remembered that the water could now only enter the vessel's hold at the main hatch, all the other hatchways having their combings above the water; and the carpenter proposed that the main hatches should now be put on, oakum being first laid along in their rabbetings, and that the cracks should be stuffed with additional oakum to exclude as much water as possible. This was done (p. 291.)

"The carpenter in the meanwhile got into a boat and went under the schooner's bows, where a whole plank was out of water; he chose a spot between two of the timbers, and bored a hole as near the surface of the water as he dared to do. Not satisfied with one hole, he bored many, choosing both sides of the vessel to make them, and putting some aft as well as forward. In the course of twenty minutes the schooner was tapped in at least a dozen places, and jets of water, two inches in diameter, were spouting from her on each bow and under each quarter.

Some water, doubtless, still worked itself into the vessel about the main hatch; but that more flowed from her by means of the outlets just named, was quite apparent. The schooner (p. 292) was slowly rising, the intense strain that still came from the brig producing that effect as the vessel gradually became lighter. By the end of half an hour there could be no longer any doubt, the holes which had been bored within an inch of the water being now fully two inches above it. The auger was applied anew, still nearer to the surface of the sea; and as fresh outlets were made, those that began to manifest a dulness in their streams were carefully plugged. The combings had now (p. 293) risen above the water. It is not to be supposed by this rising of the vessel that she had become sufficiently buoyant, in consequence of the water that had run out of her, to float herself. This was far from being the case; but the constant upward pressure from the brig, which, on mechanical principles, tended constantly to bring that craft upright, had the effect to lift the

schooner as the latter was gradually relieved from the weight that pressed her toward the bottom.

"The hatches were next removed, when it was found that the water in the schooner's hold had so far lowered as to leave a vacant space of quite a foot between the lowest part of the deck and its surface. Toward the two extremities of the vessel, this space necessarily was much increased, in consequence of the sheer.

"The cargo was then taken out gradually, the pumps were used, and the auger was used in boring fresh holes as the vessel gradually rose from the water.

"It was true, this experiment would soon cease; for the water, having found its level in the vessel's hold, was very nearly on a level also with that on the outside. Baling was also commenced fore and aft, and the schooner was ultimately raised."

Opinion.

We think, with "Nauticus," that the feat described by Cooper, is one which could never have been accomplished, under any possible state of circumstances. As long as there was a single opening for the admission of water into the vessel—the main hatch, for instance—just so long, was it beyond all human power, to raise the level of the water inside, by a single hair's breadth, above that on the outside; and, until a difference was actually established between the two levels, there could, of course, be no drawing of water off from a higher level. The simplest way, perhaps, to demonstrate this is, to suppose that a hose had been carried from a pump on the deck of the *Swash*, and its nozzle inserted into the side of the Mexican schooner some inches below the water-line; the pump, on being worked, would of course draw off plenty of water from the interior of the sunken vessel; but, what then? would the vessel have been thereby eased? Not in the least; because, for every gallon drawn off, precisely the same quantity must have flown in, to occupy its place. And even so it must have been with Captain Spike and his carpenter. Every hole they bored could but serve to increase, proportionally, the inflow of water, and so to leave matters precisely as they were.

A mathematical friend, to whom we have mentioned the case, maintains that, "even supposing the main hatch, as well as every other opening into the vessel, could have been closed while she was yet under water, that the purchases could have admitted of a still further strain upon them, and that the schooner could have been raised a "streak" or two above the sea-water line—all these things allowed, would not bring Cooper's story within the limits of possibility." We add his demonstration in his own words:—

"Suppose the vessel to be a regular geometrical figure, whose horizontal section $= a$, and depth $gh = h$; put the specific gravity of the vessel and cargo, per foot, $= W_1$, and the specific gravity of the water $= W_2$; and suppose the vessel to be filled in such proportion that its weight is $\frac{1}{2}(W_1 + W_2)\, ah$; it follows that the work done in raising the vessel through the height h, would be $= \frac{1}{2} (W_1 + W_2)\, ah^2$, if it were in the air; but the upward assistance of the water is, through the same space $h = \frac{1}{2}\, W_2\, ah^2$, and, consequently, the work to be done in raising the vessel, is $\frac{1}{2}\, W_1\, ah^2$, or the pull on the purchase at first is $\frac{1}{2}\, (W_1 - W_2)\, ah$. Now, if the water in the vessel were allowed to escape through holes in the vessel's sides, the pull or the purchase at the first lift would still be $\frac{1}{2}\, (W_1 - W_2)\, ah$; but the work done in the space h would only be $\frac{1}{2}\, (W_1 - W_2)\, ah$."—Ed. M. M.

NOTES AND NOTICES.

Fractured Window Heads.—Mr. Bartholomew, the architect, states that he counted in one day no less than 1288 cases of window heads, in the metropolis, fractured from the faulty construction of the buildings. The new palace at Pimlico has a great many in this predicament; St. Bartholomew's Hospital, about 50; Bryanstone-square Church, 18: the new Westminster Hospital, 61; the new buildings in the Middle Temple, 15; St. Mark's Church, Clerkenwell, every one of the lower range of windows. Buildings provided with stucco were invariably found to be the most defective.

Raising of Sunken Vessels.—In the *Illustrated News* of last week there is a description, with drawings, of the raising of the *Earl of Grey*, a coasting vessel of 180 tons, which was sunk in the Whittaker Channel, off the coast of Essex, in December last. The operation is stated to have been performed by means of certain "patented air-tight cases," the construction and uses of which are thus described:—"The inside cases are made air-proof by several thicknesses of Macintosh cloth, confined in an outer case of stout rope-matting; these being affixed to the chains, they are sent down at once and secured round the vessel by a self-acting stopper. The cases are collapsed when lowered, having air tubes

leading above the water, and connected with one or more force air-pumps on board the steamer or other ship aiding the operation; so that the cases, when inflated, raise the ship to the surface, without any injury to the wreck. With the ordinary cases, even at the depth of ninety feet, the actual operation of slinging and raising a wreck of any size would not occupy more than three days." We do not know who pretends to be the proprietor of this "patented" machine, but if the reader will refer to our 47th vol., p. 208, he will see that the same thing was invented twenty years ago, by Mr. John Milne, of Edinburgh, and cannot, therefore, be now the subject of any *valid* patent.

Dredge's Iron Bridges.—An iron bridge was erected in 1845, over the river Avon, in Wiltshire, between the villages of Netheravon and Harklestone, in the main road to Amesbury, through Endford from Devizes. The great public advantage, and the trivial cost of this bridge, have just led to the erection of two others on the same plan, and over the same river, in the adjoining villages, at Figheldean and Chissenbury. Up to the period of the construction of these bridges at Netheravon and Figheldean, both were very dangerous fords to cross, especially to strangers, the water being from 500 to 600 feet across, and three feet deep. At Chissenbury the new bridge supplies the place of a decayed timber bridge, that was built of English oak, in 1824; it was in three spans, with two stone piers in the middle of the river. The new bridge is in one span, which allowed the removal of the middle piers; and the cost of it was the same as the timber bridge which lasted but 24 years. These bridges were erected by a few villagers in each place, under the direction of Mr. Dredge, and neither of them occupied more than a week in its construction. Before the Figheldean bridge was finished, a carrier of the place passed over it, with his horse and cart. On being asked by the workman for a toll, he readily gave them a shilling, and said that he would always rather pay that toll than go through the water.—*Bath Journal.*

INQUIRIES AND ANSWERS TO INQUIRIES.

Electric Deposition of Metals.—"A Silversmith."—The magnetic process of the late Mr. Woolrich, which was patented about five years ago, and is fully described in our 38th volume, p. 145, is, we believe, now universally allowed to be superior to every other. Mr. J. S. Woolrich, the son of the patentee, carries on an extensive business in plating for the trade, at St. James-street, St. Paul's, Birmingham. The advantages of the magneto-plating are briefly these: The metal deposited is perfectly smooth, and the adhesion between it and its base so firm, as to be capable of standing a red heat without sustaining any injury. The silver may be deposited of any required degree of softness or hardness. And so also the quantity of silver put on the goods may be ascertained to the greatest nicety.

Worth's Rotary Pump.—"S. B., Manchester."—A full description, with drawings of this invention, will be found in No. 1017. Feb. 4, 1843.

Kew Conservatory. "H. B."—The glass employed here is of a green colour (produced, we believe, by means of the oxide of copper,) and was adopted on the recommendation of Mr. R. Hunt, for the purpose of obviating the injurious effects on vegetation of the white German sheet glass ordinarily employed in hot-houses. See vol. 47, p. 457.

Specula for Reflectors.—"In the *Mechanics' Magazine*, vol. 36, there is a letter from Mr. Lassell, of Liverpool, in which he promises to give at some future leisure time his method of grinding, polishing, and figuring specula. I have looked in vain through the subsequent volumes for this account, and shall feel much obliged by your bringing the matter to Mr. Lassell's recollection. To judge from his method of moulding, casting, and annealing specula, there can be little doubt but that he is master of the whole art of making reflectors; although it must be confessed polishing and figuring are by far the most difficult branches of the art. I understand Mr. L. has in his possession some of the best telescopes to be found in England. The reflectors he has made himself.—JOHN TAIT."

Cheap Electrical Machines.—"I shall feel obliged to your Manchester correspondent, Mr. 'J. B.,' to state of what materials he proposes to construct the cushions for his '*cheap electrical machines*,' the plates for which are described at page 515 of your Magazine. Dry flannel appears to me to be the most eligible.—J. W. LAWRANCE, Peterborough, June 9, 1848."

WEEKLY LIST OF NEW ENGLISH PATENTS.

(One only Sealed this Week.)

George Emmott, of Oldham, Lancaster, civil engineer, for certain improvements in the manufacture of fuel, and in the construction and arrangement of furnaces, flues, boilers, ovens, and retorts, having for their object the economical application of caloric, the manufacture of gas for illumination, and the consumption of smoke and other gaseous products. June 10; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
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16	1476	M'Conochie & Claude	Liverpool, engineers	Steering apparatus.
19	1477	Francis Whishaw and Co.	6, Gray's-inn Square, London	Velocentimeter and uniformity of time regulator.

NOTICES TO CORRESPONDENTS.

The Supplement to the present Volume, containing Title, Index, &c., will be published with our next Number.

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